



**COLONY AND PROTECTORATE OF KENYA**

**DEPARTMENT OF AGRICULTURE  
ANNUAL REPORT  
1949**

**VOL. II—RECORD OF INVESTIGATIONS**

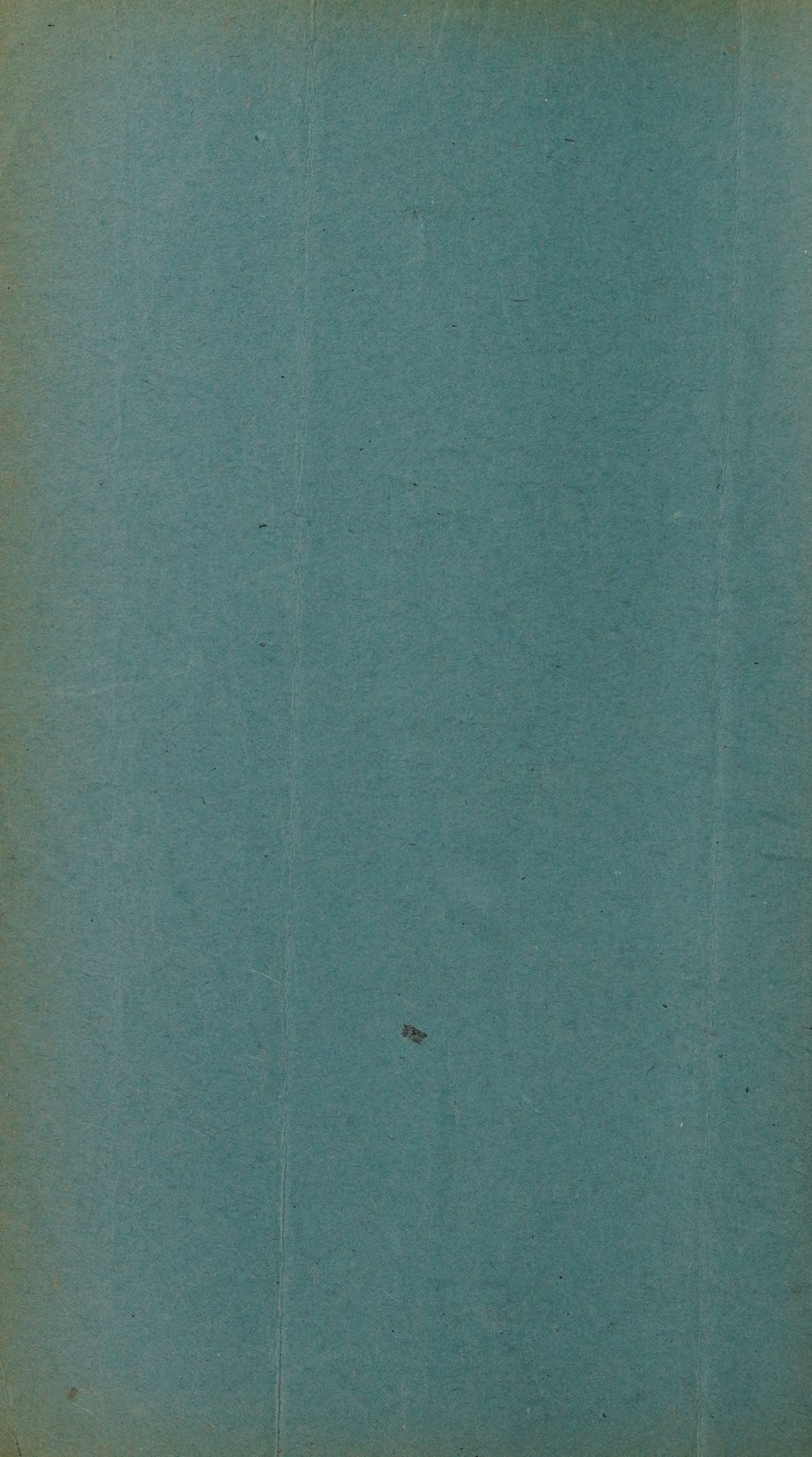


1951

PRINTED BY THE GOVERNMENT PRINTER, NAIROBI

*Price: Sh. 4/50*





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## CORRIGENDA—VOL. I

*Passion Fruit*.—Page 11, para. 3, line 3: *for* 425 lb. *read* 42.5 lb.

*Soil Conservation Service*.—Page 24, para. 3, line 3: *for* "Commercial" *read* "Communal".







# ANNUAL REPORT OF THE SENIOR ENTOMOLOGIST, 1949

## Plant Protection

*New Legislation.*—The only new legislation under the Plant Protection Ordinance, 1937, was the Plant Protection (Amendment) Rules, 1949 (G.N. 520 of 20th May, 1949), which gives powers to order treatment or disposal of plants infested with pests or diseases, powers which had been present under the old Ordinance but which had not been brought in under the 1937 Ordinance.

*Importation of Plants.*—The work of the Plant Protection Ordinance continued to increase. The plant importation permits issued numbered 916. As usual the bulk of the plant material imported was inspected by the Chief Grader and Inspector, Mombasa, but the work of inspection in Nairobi has now become heavy. The parcels examined at the Scott Laboratories and the Post Office, Nairobi, numbered 1,228, and a large volume of imports by air was also dealt with, which entailed almost daily, sometimes twice daily visits to Eastleigh or Nairobi West Aerodromes.

The year 1949 was the first full year of operation of the Plant Protection (Fines) Rules, 1948 (G.N. 953 of 17th September, 1948). The cases where material imported was intercepted because of some irregularity, either lack of the required plant importation permit, or certificate of plant health, or was infested with insects, etc., numbered 105, which is over 10 per cent of the permits issued. In 29 cases it was necessary to impose fines and these totalled Sh. 344. A number of imported plant and seed consignments were fumigated or otherwise treated before importation could be permitted, in some cases importation had to be prohibited and the material was allowed to be returned to the country of origin, and in a few cases, immediate destruction had to be carried out. The Fines Rules did not in fact result in a decrease in the number of infringements but it is confidently believed they prevented a very large increase in infringements which would otherwise have taken place. Without these Rules the whole machinery of the Plant Protection Ordinance designed for keeping pests and diseases out of the country would have been threatened, or alternatively wholesale prohibitions of importations would have had to be enforced.

The arrangements for the certification of herbaceous ornamental plants from England and Scotland operated satisfactorily throughout the year and similar arrangements were made in respect of planting material from Holland. A considerable volume of garden plants were imported from those countries with a high degree of safety offered by the special inspections and certification in the country of origin.

*Insects intercepted.*—The following insects and diseases were among those intercepted on imported plant material at Nairobi; most of these have not been fully identified:—

*Calandra oryzae* on maize and groundnuts from Somalia and on sorghum seed from Australia.

*Sitotroga cerealella* on maize and groundnuts from Somalia.

Diaspine scales on *Ficus* sp. from Tripolitania, and on various plants from Zanzibar.

Insect eggs (unidentified) on *Ficus* sp. from Tripolitania.

Worms (unidentified) on *Ficus* sp. from Tripolitania.

*Pseudococcus* sp. on *Euphorbia* from Eritrea.

*Argyroploce leucotreta* on tea seed from Tanganyika and on grapefruit from South Africa.

Mites (unidentified) on seeds of clover and grass from Australia.

*Oryzaephilus surinamensis* on peas from Australia.

*Laemophloeus* spp. on peas from Australia.

Tenebrionid beetles on peas from Australia.

Beetle larvæ (unidentified) on peas from Australia.

*Icerya* sp. on plants from Zanzibar.



Cercopid bugs on plants from Zanzibar.  
 Mites (unidentified) on tea seed from Tanganyika.  
 Thysanoptera on cut flowers from South Africa.  
 Aphididae on cut flowers from South Africa.  
*Tribolium* sp. on barley seed from New Zealand.  
 Coccinellidae on *Musa* sp. from Ethiopia.  
 Snails (unidentified) on *Musa* sp. from Ethiopia.  
 Psocoptera on clover seed from Australia.  
*Cerebella* sp. on *Paspalum* sp. from South Africa.  
*Fusarium* sp. on *Paspalum* sp. from South Africa.  
*Kabatiella* sp. on *Paspalum* sp. from South Africa.  
 Various fungi on seeds from Australia.

*Export of Plants.*—It is satisfactory to record that the export of plants to Tanganyika Territory was permitted early in the year under a certificate from this Department stating either that the mealy bug had not been known to exist in the area where the plants were grown, or that the plants had been fumigated at the Scott Agricultural Laboratories. Trade consignments were sent both from the mealy bug area and the mealy bug-free area of Kenya and the routine fumigations necessary for this purpose were carried out. Health certificates for export of plants to other countries were issued, some entailing fumigation of the material. All the material for export is given a meticulously careful examination and as a result most of the material submitted for certification is very clean since it is known that any infestation must result in rejection. Seventy-nine plant health certificates were issued and 33 fumigations carried out.

The acknowledgements of this Department are due to the Postal and Customs authorities for their helpful co-operation. I should like on behalf of this section to acknowledge the help of the Chief Grader and Inspector for his co-operation especially in the big task of inspecting the large and numerous importations through Mombasa, and it is also a pleasure to acknowledge the frequent and valued advice throughout the year of the Senior Plant Pathologist, in collaboration with whom all policy in connexion with plant importation is considered.

### General Advisory Work

Two hundred and forty-four items, either insect pests or infested plant material, were received in the laboratory for examination or advice. A large number of visitors seeking advice on insect control visited the laboratory. Advisory visits were made to farms and plantations when possible. Investigational and advisory visits were paid to Kiambu, Ruiru, Thika, Ngong, Kedong Valley.

### Maize Stalk Borer, Chafer Grub, Weevil on Wattle

The following is a report on work in the Trans Nzoia and Uasin Gishu by Mr. J. F. Graham, Entomologist:—

"Experimental work on *Schizonycha* sp., the chafer grub, which is a major pest in the Kitale District, was resumed in February.

Activity of adults was observed after heavy rain on 14th April. Prior to that date adults had been found in the soil and it may be that heavy rain ends a period of inactivity underground. Larvæ occurred in the soil from mid-May onwards, but adult beetles occurred throughout June and some laying took place in that month. Larvæ continued to occur in the soil until early November. Pupation then occurred and adults were present in the soil once again in early December.

Treatment of the soil with benzene hexachloride reduced the attacks by the grubs on maize and sunflower but the amount required would be too costly for application on a large scale. In experimental plots sown with sunflower, benzene hexachloride at the rates of 80, 160 and 320 lb. of agroicide 7 (20 per cent crude BHC) per acre all gave adequate control, the chief difference being that the higher rates gave more rapid control.



Chafer grubs were reported from wheat, maize, sunflower, lupins, sweet potatoes, couch grass, lawns, linseed and soya beans, but adult beetles attacked a much wider range of plants though the damage was normally confined to the foliage. Grubs appeared to be absent, or present in low numbers, in newly broken leys. They occurred on farms throughout the Trans Nzoia but did little damage in the Endebess soil; elsewhere there was some evidence that their numbers were declining.

Work on the stalk borer, *Busseola fusca*, confirmed that there are two generations during the normal Trans Nzoia growing season. Larvæ of the second generation were often numerous but did little damage to early planted maize. In less well-established maize the damage was considerable.

The second generation spends the dry season between November and March in maize stalk or cobs as caterpillars. These pupate after the first rains in March or April, and emerge as moths about a fortnight later. Moths were able to emerge through one inch of soil. From a compost heap of maize stalk, however, no live stalk borers were obtained.

For control two dressings of DDT or derrisol are recommended in the funnel stage, the first application to all plants, and the second, three or four weeks later, to those with perforated leaves. Composting of the maize stalk in a night boma should then destroy any larvæ present after harvesting.

Work on baiting of insect pests was successful in the case of *Dasus simplex* with 2 per cent agroside 7 in maize flour and a heavy infestation of a weevil in young wattle was almost completely wiped out with a similar bait of chopped green maize. This bait, which was relatively cheaper than contact insecticides, cleared up an infestation near Eldoret, and saved almost all of the young wattle growing on 300 acres."

J. F. GRAHAM.

### Stored Products Insects

*Lists of Insects Concerned.*—More information was collected on the range of insects affecting stored products, the beetles are now fairly well known but further work is still required on the lepidoptera. It is hoped that time will soon be found to publish an annotated list of these insects.

*Experiments with Insecticides.*—Experiments were carried out on the value of pyrethrum powder, BHC and DDT to protect maize in storage. All these substances were found to have a measure of effectiveness, but in these experiments none was found to ensure adequate protection at the doses commonly used. In one large experiment the method of application—with a bag probe and pressure gun—was considered to be at fault, and though during application dust was seen to exude from all over the bag it was found by examination that the distribution of the powder was extremely patchy being heavy near the position occupied by the probe and negligible at appreciable distances from this position. The protection by standard doses in this experiment was poor, due it is considered chiefly to this uneven distribution. The results are considered virtually to rule out this method of application as a practical proposition. The detailed results of this experiment could not be prepared for publication during the year but will be published as soon as possible.

*Visit of Specialist.*—In December, 1948, and January, 1949, Mr. T. A. Oxley, head of the Biology Section of the Pest Infestation Laboratory of the Department of Scientific and Industrial Research, Slough, England, paid a visit to Kenya, to study and advise on grain storage problems. The Senior Entomologist arranged an itinerary for him to see the problems in different parts of the country, and had the pleasure of accompanying him during most of his visits and experiments in and about Nairobi. We have been glad to receive his interesting and valuable report covering storage problems in Kenya and many other parts of East Africa.

*Stored Products Inter-departmental Committee.*—Following a suggestion from the Secretary of State for the Colonies an inter-departmental committee was set



up to ensure that the subject of pest infestation of stored products received the full and sustained consideration which its economic importance warrants, and to advise the administration regarding any steps necessary to prevent or reduce existing losses. The Senior Entomologist was appointed Chairman of this Committee, and other members were the Maize Controller and a Senior Medical Officer representing the Medical Department. This Committee was set up in September and the first meeting was held in November. The Senior Entomologist was also appointed official Kenya correspondent with the Pest Infestation Laboratory.

### Fruit Flies

*Visit of Biological Control Specialist.*—From July to the end of the year an official American expedition led by Mr. James M. McGough was present in Kenya to collect parasites for the control of fruit flies in the Hawaiian Islands. It was a great pleasure to be able to provide some laboratory accommodation for this work and its progress was followed with interest. A very large number of shipments of parasitized material were sent by air to Honolulu by Mr. McGough.

Through the kindness of Mr. McGough I am able to give a preliminary list of some of the fruit flies reared by him in Kenya during 1949, with host fruits and localities, the identification of the fruit flies being by Dr. H. Munro of South Africa, the well-known specialist on fruit flies.

| Trypetid                                          | Host Fruit                              | Locality                                                        |
|---------------------------------------------------|-----------------------------------------|-----------------------------------------------------------------|
| <i>Pardalaspis cosyra</i> (Wlk.)                  | .. <i>Warburgia ugandensis</i>          | .. Nairobi-Naivasha<br>Escarpment                               |
| <i>Pardalaspis cosyra</i> (Wlk.)                  | .. <i>Landolphia florida</i>            | .. Teita Hills                                                  |
| <i>Pardalaspis simi</i> Mro.                      | .. <i>Acokanthera friscorium</i>        | .. Nairobi-Naivasha<br>Escarpment                               |
| <i>Pardalaspis lobata</i> Mro.                    | .. <i>Strychnos</i> sp.                 | .. Nairobi                                                      |
| <i>Pardalaspis contramedia</i> Mro.               | .. <i>Warburgia ugandensis</i>          | .. Nairobi-Naivasha<br>Escarpment                               |
| <i>Ceratitis capitata</i> (Wd.)                   | .. <i>Coffea arabica</i>                | .. Kiambu                                                       |
| <i>Ceratitis capitata</i> (Wd.)                   | .. <i>Strychnos</i> sp.                 | .. Nairobi                                                      |
| <i>Ceratitis capitata</i> (Wd.)                   | .. <i>Doryalis caffra</i>               | .. Nairobi                                                      |
| <i>Ceratitis capitata</i> (Wd.)                   | .. <i>Photinia japonica</i> (Loquat)    | .. Nairobi                                                      |
| <i>Pterandrus rosa</i> (Ksh.)                     | .. <i>Coffea arabica</i>                | .. Kiambu                                                       |
| <i>Pterandrus rosa</i> (Ksh.)                     | .. <i>Doryalis caffra</i>               | .. Nairobi                                                      |
| <i>Pterandrus rosa</i> (Ksh.)                     | .. Guava                                | .. Bukura<br>Kakamega                                           |
| <i>Pterandrus curvatus</i> Mro.                   | .. <i>Strychnos</i> sp.                 | .. Nairobi                                                      |
| <i>Dacus</i> ( <i>Daculus</i> ) <i>oleae</i> Gml. | .. <i>Olea chrysophylla</i>             | .. Nairobi-Naivasha<br>Escarpment,<br>Nanyuki                   |
| <i>Dacus oleae</i> Gml.                           | .. <i>Euclea</i> sp. (Ebenaceæ)         | .. Nairobi                                                      |
| <i>Dacus bivittatus cucumaris</i> Sack.           | Cultivated cucurbits                    | .. Nairobi,<br>Naivasha,<br>Machakos,<br>Dandora nr.<br>Nairobi |
| <i>Dacus ciliatus ciliatus</i> Lw.                | .. Cultivated cucurbits                 | .. Nairobi,<br>Naivasha,<br>Machakos,<br>Dandora nr.<br>Nairobi |
| <i>Dacus bivittatus cucumaris</i> Sack.           | Vegetable marrows                       | .. Teita Hills,<br>Mombasa                                      |
| <i>Dacus vertebratus</i> Bez.                     | .. <i>Cucumis aculeatum</i>             | .. Lower Kabete                                                 |
| <i>Xanthorrhachista alata</i> Beck.               | .. <i>Solanum</i> nr. <i>melanogena</i> | .. Ngong Forest                                                 |



**Control by Poison Baits.**—A good deal of fruit, particularly peaches, is lost almost every year through fruit flies. The commonest insect in peaches is generally *Pterandrus rosa*, but *Ceratitis capitata* is also found. Cucurbits are also regularly attacked by species of *Dacus*. In view of the frequency of inquiries for control measures for these insects it was decided to try out a number of baits in the field and fortnightly visits from October to December were made for this purpose to a peach orchard near Ngong. Unfortunately, for this work, for the first time in years, fruit fly infestation was absent or so very low in this orchard that the experiments capably conducted by Mr. R. G. Smith were without result.

In the laboratory, however, it was possible to carry out several useful baiting trials with fruit flies kindly made available by Mr. McGough. The following was found to be a most effective bait:—

40 per cent nicotine sulphate: 1 fluid oz.

Sugar: 1½ lb.

Water: 3 gallons.

BHC and Parathion were both found effective in baits though the last mentioned would not be recommended in practice owing to the toxic hazard. DDT in baits was not found to be effective. Both nicotine and BHC are considered to show promise of effective use in the field.

### Forest Entomology

At the request of the Conservator of Forests, the Senior Entomologist acted as entomological adviser to the Forest Department from January until July, during the absence on leave of the Forest Entomologist. Time did not permit investigational work to be undertaken, but one visit was paid to the Londiani Forest Station and to saw mills, and a number to the Command Engineer's Store, Nairobi, in connexion with a serious infestation of wood borers in a large stack of mvule timber. Advice was given which enabled a quantity of timber to be saved. Routine advisory correspondence on entomological matters was also carried out for the Forest Department during the period mentioned.

### Desert Locust

At the end of 1948 after the establishment of the Desert Locust Survey a Desert Locust Advisory Committee was set up to advise the East Africa High Commission on matters relating to the work and policy of the Survey. Dr. R. Le Pelley became a member of this Committee and attended all meetings of the Committee throughout the year.

By the end of 1949 the Survey reported that *transiens* locusts were present in British Somaliland which might be undergoing further congregation leading to the formation of the gregarious phase.

### Biological Control of *Saissetia oleæ* in California

At the request of the Division of Biological Control, Riverside, California, collection of *Saissetia oleæ* was begun, in an attempt to find and send the species of *Encyrtus* which they had previously obtained from Nairobi, but of which the breeding stock had been lost. One consignment of *Saissetia oleæ* was sent by air mail to California in November, but it was not possible to send any further shipments during the year.

### Prickly Pear

Further trials to control this weed with various modern weed killers have been undertaken, but none of the substances used was effective and nothing approaching the effectiveness of DNOC in diesel oil has been found. Practical control can be achieved by spraying with this material and then digging out the stumps. It is not suggested that this is likely to prove an easy or cheap method, but it is a possible one where control is considered essential.



### Termite Control

Experiments were begun and continued from time to time in the control of termites (mostly *Odontotermes badius*) particularly with benzene hexachloride smoke produced from smoke generators used in a special high-pressure applicator of the type designed by Coaton in South Africa and following his pioneer work in this field. The applicator used was constructed by a local firm and proved very satisfactory. The method has not produced 100 per cent kill of nests and at the end of the year experiments were still continuing. The method shows great promise and is considered an advance on any previous control, but the trials did not arrive during the year at a stage when it could be recommended for general application. The method is not cheap, and this fact alone may prevent its general adoption.

*Harvester Termites*.—An infestation of harvester termites, presumably *Hodotermes mossambicus*, was reported on a farm in the Kedong Valley. A visit was paid which showed that considerable damage to grass was occurring over an appreciable area. Baiting experiments were suggested but opportunity to carry them out did not occur during the year.

### Jacaranda "Blight"

(*Orthezia insignis*)

In a trial of sprays of DDT, BHC, HETP, Parathion and also some proprietary sprays containing various insecticides, all at strengths generally recommended against Coccidæ, all sprays proved ineffective against *Orthezia*.

### Army Worm

Tests of various insecticides in the form of sprays and dusts as an alternative to bait were tried on a small field scale against army worm larvæ (*Laphygma exempta*). The materials showing to best advantage were DDT wettable powder at 0.1 per cent in water, a DDT dust at 2 per cent and a fine ground pyrethrum dust (about 1 per cent total pyrethrins). BHC while promising in baits was not effective as a dust.

### Dusty Ground Beetle

This Tenebrionid (*Dasus simplex*) is a well known pest, cutting many species of plants at ground level. It was reported many times during the year and was more common than usual, causing a good deal of damage especially to maize and wheat. BHC has been found to be a satisfactory toxicant in baits and has largely replaced arsenic.

### Diamond Black Moth

(*Plutella maculipennis*)

Trials of sprays and dusts on young cabbage plants heavily infested with *Plutella maculipennis* larvæ showed that 0.1 per cent DDT spray and 2 per cent DDT dust were effective, the spray being slightly better, producing a kill of 98 per cent to 99 per cent.

### Banana Weevil

(*Cosmopolites sordidus*)

The first record for Kenya of this notorious pest of bananas occurred in August when it was found in one location of the North Nyanza District. It may have been present there for some time and no doubt has spread from Uganda, possibly in suckers brought in for planting. It occurs also in parts of Tanganyika Territory and before the end of the year it had been found in one area in the Kwale District of the Coast Province, but is believed not to be very widely spread in this country at the present time.



### Pineapple

Two pests on pineapples have caused concern during the year, the mealy bug, *Pseudococcus brevipes*, on plantings at Mwatati and the scale, *Diaspis bromeliae*, at Thika. At Mwatati new plantings suffered severely from drought and attack of *Pseudococcus brevipes*. Mealy bug wilt occurs in this area and in the prevailing dry conditions it may always be expected to be more severe than in areas of higher rainfall and greater fertility. White oil emulsion was used as dip for planting material to avoid the spread of mealy bug by this means. While of value there was evidence that it did not result in complete destruction of the insects on all suckers. At Thika a heavy infestation of *Diaspis bromeliae* occurred over many acres of young planted pineapples, having been spread by infested planting material. White oil emulsion with tobacco extract was used with some success as a spray for young plants, but less than complete control was obtained: wettable DDT at 0.1 per cent also did not secure complete control. White oil emulsion was used with success to dip all suckers for planting and it is believed that freedom from scale was obtained by this means, without damage to the suckers. This scale was found to be parasitized by an internal hymenopterous parasite, so far unidentified, and other natural enemies undoubtedly occur.

### Insecticides

The use of different insecticides is mentioned under the pests concerned but a few general remarks are added.

Perhaps the most interesting development is the fact that BHC has proved to be an effective substitute for arsenic in baits against a number of insects. It is now possible to recommend it with confidence in baits against many insects. DDT dust continues to be effective against maize stalk borer, and has other uses as a spray or dust. Parathion so far only tested on a very small scale seems to have considerable promise, its chief disadvantage being its acute toxicity to man. Satisfactory opportunities to test systemic insecticides did not occur during the year. A large number of visits were made to the laboratories from representatives of firms interested in marketing insecticides. While the market for insecticides in this country is only a small one at present it is increasing yearly.

### Miscellaneous Pests

Apart from pests already mentioned, the following were among those recorded as doing damage during the year:—

*Eriophyes pyri*, pear leaf blister mite on pear at Londiani; *Megalognatha* sp. (Galerucidae) on cherry and peach at Eldoret; *Oothea* sp. (Galerucidae) on beans at Eldoret; *Dasus simplex* (Tenebrionidae) attacking maize at Kisumu, wheat at Ol Joro Orok and Eldoret, sunflower at Nanyuki, tea seedlings at Kericho, tomatoes at Songhor; red spider mites (unidentified) on plum and Cape gooseberry at Molo; *Epilachna hirta* (Coccinellidae) on potato and tomato at Naivasha; *Phytometra orichalcea* (Noctuidae) on maize at Endebess; *Argyroplote leucotreta* (Euscosmidae) in citrus fruit at Ngong; *Dacus* sp. (Trypetidae) in marrows at Nairobi and Naivasha; *Pterandrus rosa* (Trypetidae) on coffee at Kiambu, peaches at Ngong and guava at Bukura; *Heliothis obsoleta* (Noctuidae) on Bengal gram at Njoro.

### Visit of Dr. Hall

In March, Dr. W. J. Hall, Director of the Commonwealth Institute of Entomology, visited Nairobi and stayed a few days. This afforded an opportunity to discuss a number of entomological matters and the visit was very much appreciated.

### Acknowledgments

I should like to pay a tribute to the good work of European and African members of the staff of this section. It is sincerely hoped that vacancies on the establishment of Entomologists will be filled in the near future.

I wish especially to mention the severe loss to the section, through the retirement on account of ill health of Mr. C. F. Fox. His outstanding work for the section over many years requires a special tribute.

I wish to thank the Maize Controller for facilities accorded for experiments on stored products insects, this help is very much appreciated.

It is a pleasure to record once again, the great assistance of the Commonwealth Institute of Entomology with advice and identifications.

R. LE PELLEY,  
*Senior Entomologist.*



# ANNUAL REPORT OF THE SENIOR PLANT PATHOLOGIST, 1949

## Field Crops

From the 30th May to the 9th June, I visited Uganda at the invitation of the Director of Agriculture, Entebbe. From the 4th November to the 4th December, I visited the Union of South Africa on behalf of the East African Agriculture and Forestry Research Organization. Reports on both these visits have been submitted.

An article, "A *Botrytis* disease of *Eucalyptus* in Kenya" was published in the Empire Forestry Review, January, 1949.

The chapter on "Plant Diseases" for the new edition of "Gardening in East Africa" was re-written for the Kenya Horticultural Society.

During the year a total of 294 specimens of diseased plant material was received at the laboratory for diagnosis and report from members of the public and officers of the Department.

*Potato*.—Blight, *Phytophthora infestans*, was again widespread, especially at the higher altitudes where the crop is subjected to a wet growing period. The advantage of early planting and a short period variety is demonstrated. Potatoes grown under irrigation have escaped the blight altogether.

Severe attacks of Common Scab, *Actinomyces scabies*, occurred in two localities. *Fusarium oxysporum* was the cause of a tuber rot in storage and a wilt of plants was caused by black leg, *Bacillus phytophthorus*. A bacterial rot of potato tubers in the field was attributed to the initial effect of high surface soil temperature. Physiological hollow heart and tuber cracking occurred in some areas.

*Pyrethrum*.—The "Bud Disease", *Ramularia bellunensis*, although widely present was less serious and towards the end of the year was found only with difficulty. Specimens of the disease were received from the Nanyuki district, which district had hitherto remained free from the disease. Root and crown rot, associated with *Fusarium graminearum* and *Sclerotinia minor*, occurred in various localities.

*Cereals*.—"Take All" of wheat appeared to be widespread in the main wheat areas. *Puccinia graminis*, *P. glumarum* and *P. triticea* were sent in for identification. Diseases of the ears included *Septoria nodorum*, *Epicoccum purpurascens*, and *Alternaria* spp., *Fusarium* sp. and *Periconia circinata* were isolated from seedlings.

Severe yellowing of wheat was attributed to the leaching out of available nitrogen during heavy rains. No instance of "Bunt" was received. There is some evidence that incidence of loose smut may be on the increase.

Covered smut of barley was observed in seed samples.

Oats suffered severely from rust, *Puccinia lolii*.

The presumed bacterial disease of maize, referred to in the previous report, was again prevalent in the Trans Nzoia. The nodes and developing cobs and tassels are the parts affected, where a wet rot, quickly overrun by *Fusarium* occurs. The disease, which it has not yet been found possible to investigate adequately, appears to bear some resemblance to that caused by *Pseudomonas alboprecipitans* in America.

*Fusarium moniliforme* and *F. graminearum* were received for report on cob and loose grain.

A disease of rice, the symptoms of which were death of the roots and empty ears was received from two localities on the Coast. Cultural work failed to reveal any significant fungus. *Sclerospora sorghi* was received from the Nyanza Province on sorghum. A species of *Epichloe* occurred on *Sporobolus fimbriatus*.

**Legumes.**—"Chocolate Spot" on broad beans, similar in appearance to that occurring in Europe, was also shown to be caused by *Botrytis* sp. indistinguishable from *B. cinerea*. Lucerne from a number of localities was attacked by *Pseudopeziza medicaginis* and *Pseudopeziza trifolii*. An obscure disease of lucerne occurred in the Ol Joro Orok district. The general effect was a slow spreading die-back with a thickening of the cortex at, and slightly above soil level. No specimens were seen of the disease in the initial stages. *Corticium solani* in one locality caused a stem rot of French beans. *Erysiphe polygoni* and *Ascochyta pisi* were again prevalent on peas.

Sunflower, *Helianthus annuus* was severely attacked by rust, *Puccinia helianthi* and by the "white rust", *Cystopus tragopogonis*. Considerable loss was caused in one instance by *Sclerotinia minor*, stem rot.

**Fruit.**—The widespread occurrence of virus diseases of plum and apple has been confirmed from observations made by the Officer-in-Charge of Horticulture. Plum chlorosis and apple mosaic appear to be identical with the two diseases described from the Union of South Africa. Both these diseases have, without doubt, been introduced into Kenya with infected nursery stock from the Union. There is, as yet, no evidence of spread of the disease from tree to tree in the orchard.

Apple and peach trees were killed by *Armillaria mellea* in orchards on old forest land and Boysenberry canes were killed by *Rosellinia necatrix*. An example of stony pit of pears was sent in to the laboratory. A fruit rot of pears on the tree starting with small circular lesions was caused by *Botrytis cinerea*. *Cladosporium carpophilum* was seen for the first time on plum. *Fabraea maculata* was found severely attacking quince. Miscellaneous diseases of fruit trees were similar to those sent in in previous years.

**Vegetables.**—Tomato blight, *Phytophthora infestans* was again widespread and caused much destruction of the crops except dry season crops grown under irrigation. Blossom end rot was a frequent cause of inquiry. Other diseases received were caused by *Alternaria solani*, *Septoria lycopersici* and *Fusarium sambucinum*.

An apparent virus disease, with foliage symptoms resembling those of "Bunchy Top" caused considerable loss in two commercial plantations. The fruit, however, was not noticeably reduced in size but showed yellow blotching when coloured and from an early stage became soft and unmarketable.

Cucurbits suffered from downy mildew, *Pseudoperonospora cubensis*, in various localities and powdery mildew, *Erysiphe cichoracearum*, was everywhere present. In spraying trials against the latter, a dispersible sulphur gave better control than either sulphur dust or burgundy mixture. Sweet melons were damaged by stem canker, *Mycosphaerella citrullina*.

Purple blotch of onions, *Alternaria porri*, was recorded for the first time. Two samples of Egyptian onions were examined for suspected smut, *Urocystis cepulae*. In both instances, *Aspergillus niger* was the fungus present. *Cystopus candidus* caused considerable damage to commercially grown cabbages and cauliflower. *Alternaria brassicae* was seen for the first time on turnips.

*Rosellinia necatrix* and *Pestalotia theae* were received on specimens of tea. An undetermined disease of castor oil, resulting in atrophy of the flowering spikes occurred on an irrigated estate at Taveta.

**Ornamentals.**—The following diseases were sent into the laboratory: wilt of *Antirrhinum*, *Phytophthora cactorum*, *Septoria dianthi* and *Uromyces caryophyllinus* on carnations, powdery mildew and stem rot. *Xanthomonas* sp. on delphinium, *Fusarium* wilt of *Gillia* and *Sclerotinia sclerotiorum* stem rot and *Ascochyta* leaf spot on Pentstemon.

The Bulb Eelworm disease caused by *Anguillulina dipsaci* has been found for the first time in Kenya on daffodils.



A disease of wattle (*Acacia mollissima*) on the Plateau continues to cause loss of young trees. Swelling and cracking of the bark and distortion of the stem is accompanied by a swollen tap root and occasionally severe pitting of the wood in the region of the collar. The disease may be a physiological one or be due to a virus. An undetermined fungus isolated from diseased root tissue is under investigation. *Armillaria mellea* caused the death of *Acrocarpus fraxinifolius* and *Cordia Holstii*. *Pythium ultimum* was the cause of "damping off" of *Pinus patula* seedlings.

The research work on the *Monochaetia* canker disease of *Cupressus*, referred to in my previous reports, has now been taken over by the East African Agriculture and Forestry Research Organization.

Experiments were carried out at the request of the East African Timber Co-operative Society to test the relative merits of two proprietary timber preservatives.

During the year, 55 fungi were sent to the Commonwealth Mycological Institute. The following determinations have been received:—

*Pythium ultimum* from *Pinus patula*; *Phytophthora cactorum* from antirrhinum; *Absidia glauca* from pyrethrum; *Alternaria linicola* from flax; *Alternaria zinnee* on Zinnia; *Alternaria brassicae* on turnip; *Alternaria porri* on onion; *Epicoccum purpurascens* on wheat; *Aspergillus ostianus* on chicory seed; *Fusarium moniliforme* from Crotalaria; *Fusarium oxysporum* from Pelargonium and potato tuber rot; *Fusarium solani* from carnation; *Fusarium sambucinum* from tomato; *Fusarium graminearum* from maize and *Fusarium avenaceum* from flax; *Septoria lablabina* on *Dolichos lablab*; *Mycosphaerella citrullina* on melon; *Phomopsis juniperovora*, *Phyalospora obtusa*, *Cytospora* (?) *cupressina* and *Botryodiplodia* sp. on *Cupressus*; *Pestalotia natalensis* on wattle; *Phragmodiscus arundinariae* on bamboo; *Melanopsichium austro-americanum* and *Ustilago utriculosa* on *Polygonum* sp.; *Ustilago flagellata* on *Rottbellia exaltata*; *Ustilago rabenhorstiana* on *Digitaria horizontalis*; *Puccinia granularis* on wild geranium and *Uromyces aloes* and *Montagnella maxima* on *Aloe* sp.; *Mucor spinosus*.

**Wheat Stem Rust.**—The eight physiologic forms of wheat stem rust were maintained in culture on living wheat plants during the year. An H.E.T.P. insecticide has been successfully used in the cages to control aphids and red spider, pests which have hitherto made the maintenance of the rust forms extremely difficult.

The latest form No. 8, has been bred up in order to test all the new wheat hybrids for resistance. Eighty-three hybrids were so tested during the year. Of these, 24 were found to be susceptible to the new form.

Physiologic form 8 has also been inoculated on to the twelve differential wheat varieties used by Stakman and Levine for the classification of physiologic forms. From the reactions on these varieties, form 8 appears to be identical or very close to Stakman and Levine's form 24.

From the collections of rusts received for determinations of the physiologic forms, what is probably yet another form, No. 9, has emerged and is being studied.

**Blight Resistant Potatoes.**—Further distributions of the stock of blight resistant potatoes grown at the Scott Laboratories have been made to farmers and to the Agricultural Officers in charge of the Kiambu and Nyeri native areas and to the Agricultural Officer, Kitale. A further stock of 914a12 and 1427a8, which previously had shown considerable promise, was imported from Corstophine and sent direct to the experimental station at Ol Joro Orok for multiplication in isolation at a high altitude. Arrangements have been made for the multiplication of nucleus stocks to be done on a site on the Aberdares (8,500 ft.) where, as far as is known, aphids do not occur.

The potatoes previously obtained and now grown commercially, 914a12, 1082a28, and 1095b22 have yielded well and proved popular. Up to 1948, being immune from blight forms A and C, these potatoes were not attacked. The advent of another form now makes them liable to attack and in the field all showed some blight attack. Nevertheless, in spite of a late attack of blight, heavy yields were obtained on the Kinangop, 914a12 yielding as much as 5 lb. to the plant.

Early in the year, a further six new hybrids were received from Dr. Black and have been grown for two seasons at the Scott Laboratories.

### Seed Testing Laboratory

During the year, 631 samples were received for analytical purity and germination tests. This represents an increase of 342 over the number of samples received during the previous year. The samples tested comprised cereals, 195; peas, 131; sunflower, 12; vegetables and miscellaneous crops, 133; grass seeds, 51, and miscellaneous flower and tree seed.

Tests were carried out for the Agricultural Officer (Pyrethrum) on the effect of certain ranges of temperature on germination of pyrethrum seed. It was found that pre-chilling had a depressing effect on germination. A low germination temperature but without pre-chilling improved the speed of germination, whereas high temperatures lowered the speed of germination.

Tests of various treatments to increase the speed of germination of *Urena lobata* seed were carried out. These included scarification treatment with acid and dry and wet heat. The most effective treatment was immersion of seeds in boiling water which was then left to cool. The seeds were then sun-dried and sown as soon afterwards as possible.

Germination tests for the Entomological Section of fumigated and control samples of tea, coffee, cotton and maize were done. In no instance had fumigation any deleterious effect on germination.

Seventy-four species of plants were raised from unidentified weed seeds extracted from local and foreign seed samples, for preservation and identification. Most of these were exotics.

Inquiries dealing with weeds and other wild plants were dealt with.

A number of seed samples were examined in the Pathological Laboratory for seed-borne pathogens. Cereals and grasses yielded:—

*Fusarium graminearum*, *Cladosporium herberum*, *Epicoccum purpurascens*, *Alternaria* spp. *Ascochyta* sp. was isolated from samples of pea seed.

A sample of chicory seed from England, which failed to germinate, was found to be infected throughout with *Aspergillus ostianus* Wehm.

R. M. NATTRASS,  
Senior Plant Pathologist.

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# ANNUAL REPORT OF THE SENIOR SOIL CHEMIST, 1949

## Analytical Services

The total number of samples dealt with during the year amounted to 1,426 as compared with 1,349 for the previous year. Though the Chemical Section does carry out analyses for agriculturists, for which scheduled charges are made, this work constitutes only a small portion of the total analyses carried out. Analyses, for which scheduled charges were made, were limited to sixty-two samples, made up mainly of fertilizers, feeding stuffs, pyrethrum, tannin barks, waters and a few soil samples where laborious quantitative analysis were demanded. The total receipts for such analytical work amounted to £185. The remaining 1,364 samples were classified under "free services to agriculturists" and "investigational work".

A summary of the different classes of samples analysed, including those involved in investigational work, is as follows:—

|                                  |                   |
|----------------------------------|-------------------|
| Soil .. .. .                     | 650               |
| Pyrethrum .. .. .                | 199               |
| Feeds and Feeding Stuffs .. .. . | 157               |
| Pot Culture Work .. .. .         | 154               |
| Manures and Fertilizers .. .. .  | 69                |
| Rain Water .. .. .               | 63                |
| Water Supplies .. .. .           | 36                |
| Tobacco .. .. .                  | 34                |
| Miscellaneous .. .. .            | 64                |
| Total ..                         | <hr/> 1,426 <hr/> |

A study of the soil samples shows that of the total of 650 analysed, 505 samples were examined in connexion with advisory services to farmers, and the remaining 145 analyses were in connexion with investigational work. Of this total of 505, it is interesting to note that 102 samples were sent in by Agricultural Officers on the behalf of 17 farmers and 403 samples were submitted direct by 78 farmers. There has been a continued interest in the examination of soil samples in connexion with the establishment of tea plantations, as shown by the submission of 169 soil samples in large batches by nine interested parties. The 157 samples of feeds and feeding stuffs analysed included cattle cakes, abattoir by-products, cereal feeds, fodder crops, silage, linseed for oil content and maize for moisture content. The 69 samples of manures and fertilizers comprised composts, farmyard manure, poultry manure, straight and compound concentrated fertilizers, Seychelles phosphate and wood ashes. The water samples analysed were in connexion with their suitability for irrigation purposes and for farm use. Some river water samples were analysed for their silt content. Samples classed under "miscellaneous" included tannin barks, essential oils, fibres, toxic materials, drying and cosmetic oils, fungicides and natural licks.

For many years, agriculturists have been advised that, wherever possible, they should make their inquiries in person at the Laboratories rather than by correspondence so that their problems can be more fully discussed. During the year, some 600 people called on the Senior Soil Chemist and though these interviews took up a fair amount of time, they are more satisfactory than correspondence and are to be encouraged.

### Investigational Work

The main item of investigational work done throughout the year has been further biological assays of the availability of different phosphatic fertilizers. The Highland and Native Fertilizer Experiments Schemes, now in progress in East Africa, have confirmed earlier trials carried out by the Department that most local soil types give a good response to phosphatic manuring. The provision of adequate and suitable supplies of cheap phosphatic fertilizers is bound to play an important role in the development of more intensive farming in the future. In the past Kenya has been dependent on supplies of imported phosphates mainly of the superphosphate class. The discovery of vast deposits of a primary rock phosphate in Uganda has made it possible for East Africa to obtain future supplies of phosphatic fertilizers of local origin and manufacture. It has been shown that raw Uganda rock phosphate even when very finely ground is not sufficiently available for use by itself with annual crops and that there was need to prepare from it a much more available fertilizer. The final decision on the most economic and suitable form to synthesize will have to be decided later. In the meantime a promising phosphatic fertilizer, which has become known as sodaphosphate, has been prepared by calcining Uganda rock phosphate with Magadi soda. A local firm has already started the production of this new fertilizer and there is urgent need to obtain further data on its manurial value. Laboratory studies have been carried out in parallel with the laborious field experiments referred to above. Further pot culture and field plot trials with this new locally prepared fertilizer have been continued at the Scott Agricultural Laboratories. Earlier work referred to in these Annual Reports dealt with the early uptake of phosphates by cereal seedlings grown for 18 days only in variously treated soils in shallow containers. New work done during the year dealt with the relative extra uptake of the essential nutrient from larger masses of soil in containers and under field conditions.

#### *Further Biological Assays of the Availability of Different Phosphatic Fertilizers*

Four main trials were completed to note the availability of phosphatic fertilizers to a sequence of seedling growths and field cuts of Rhodes grass and also the effects of increasing concentration and methods of placement on relative root-solubility.

A sequence of cereal seedlings and grass was grown in containers holding 45 lb. of soil and giving a depth of 12 in. to which heavy dressings of Uganda rock phosphate, sodaphosphate and triplesupers, supplying 1,000 ppm of total  $P_2O_5$  for the former and 500 ppm for the latter two, had been added. There were triplicate lots of each treatment and six controls. Rhodes grass and wheat seedlings were grown and cut for analysis in the young stage, followed by a second crop of rye which was similarly analysed for its phosphate content. From the start the growth of Rhodes grass was much more vigorous following the addition of all three classes of phosphates; the resultant hay weights, when cut at 47 days, were about three times greater than for the grass grown in the untreated soil. When the oven-dry grass cuts were analysed for phosphate content, it was found that, in spite of a much greater mass of growth produced, grass grown in soils to which sodaphosphate and triplesupers had been added contained as much as 1.3 per cent of total  $P_2O_5$  as compared with .3 per cent only for the grass from the untreated soil. That grown in the soil which had received a dressing of Uganda rock phosphate contained .5 per cent  $P_2O_5$ . The about similar, much better growth in all the treated soils showed that the two lots with 1.3 per cent of contained phosphoric oxide had absorbed luxury uptakes of this nutrient.

The vigour of growth and final dry matter weight of the wheat and rye seedlings were only slightly better for the treated soils, but analysis of the oven-dried cut seedling shoots showed that they contained about 1.7 per cent  $P_2O_5$  following the addition of triplesupers and soda phosphate and about half this content with



the double dressing of Uganda rock phosphate, as compared with about .5 per cent for similar seedlings grown in untreated soil. This trial showed that soda-phosphate was about equally readily available as triplesupers. After allowing for the increased bulk of growth and the high percentage of contained  $P_2O_5$ , the recoveries of added phosphate are very high and of the same order for soda-phosphate and triplesupers. The recovery was about five to six times that obtained with Uganda rock phosphate.

The next step in these studies was to pass on to field conditions to note the long-term uptake of phosphates following the broadcasting and mixing with the surface soil of the same three kinds of fertilizers. The rates of application were 500 lb. total  $P_2O_5$  per acre in the form of Uganda rock phosphate and half this quantity in the form of sodaphosphate and triplesupers. These plots were seeded to Rhodes grass. They serve two purposes: firstly, a study of what happens over the years to these three different classes of fertilizers when added to the lateritic, acid soil type at the Scott Agricultural Laboratories and, secondly, a study of the availability of these fertilizers, year by year, in terms of extra phosphate uptake, as shown by the analyses of a series of Rhodes grass cuts.

From the start, the triplicate plots which had received all three forms of phosphates at the dressings quoted, showed a more healthy and more bulky growth of seedlings and there was a clear division along the boundaries between the treated plots and the controls. After five weeks' growth, quadrant sample cuts from triplicate plots under each of the three treatments and from six control plots were taken for analyses and later, all plots were cut at the hay stage at nine weeks. Later on, following the rains, similar quadrat cuts of lush aftermath growth were taken for further analyses. The percentage  $P_2O_5$  in the oven-dry-matter for the two successive cuts indicated the extra amounts of phosphates available in the treated soils and also the relative root-solubility of the three fertilizers over the two growth periods.

The mean percentage  $P_2O_5$  content of the five weeks' seedling growth from the control plots was .75 per cent. Similar samples taken from the Uganda rock phosphate plots contained 1.0 per cent  $P_2O_5$ , showing that large dressings of finely ground Uganda rock phosphate had contributed much available phosphates to the seedlings even over this short period of growth. The mean percentage  $P_2O_5$  contents of the seedlings from the sodaphosphate and triplesupers treated plots were 1.30 per cent and 1.26 per cent respectively. The half-dressings of soda-phosphate and triplesupers thus gave very marked and about similar increases in the phosphate content of the Rhodes grass seedlings. The analyses of the aftermath samples taken six months after applying the fertilizers gave some very interesting results. In all cases, the aftermath contained less phosphates than the first cut after five weeks of growth. The cuts from the control plots, based on oven-dry-weight, contained .6 per cent  $P_2O_5$ . Those from the Uganda rock phosphate plots averaged .72 per cent, and those from the triplesupers plots averaged .78 per cent, whereas the cuts from the sodaphosphate plots contained as much as 1.0 per cent. These results suggest that six months after application sodaphosphate had a greater "residual availability" than triplesupers. Further growth samples will be analysed over a number of years to note the relative residual availability of these three classes of phosphatic fertilizer.

Having obtained information on the early and later relative "root-solubility" of triplesuper phosphate and sodaphosphate when mixed throughout the soil in pots and when broadcast in the field, the next trial arranged was to compare the phosphate uptake from these two phosphatic fertilizers when they were "placed" with wheat sown 7 in. apart. There were six rows per treatment, of which the middle four only were used for sampling and analysis. The methods of placement were—in the row, between the row, and between alternate rows, with control rows receiving no phosphates. Other influencing factors were eliminated by using equal

dressings, in terms of total  $P_2O_5$ , of similarly ground materials mixed with an equal mass of soil at specified positions of lateral distance and depth and the maintenance of a similar stand of plants without competition by weeds. The applications were calculated to supply 100 ppm total  $P_2O_5$  based on the total mass of a 5-in. depth of soil in the containers. The enriched soil in the placement zone contained 1,170 ppm added total  $P_2O_5$ , giving a dilution of sodaphosphate with about 200 parts of soil and about double this dilution for the more concentrated triplesupers. With such a dilution, it was known that there could be no danger of the 2.8 per cent of contained sodium carbonate in the sodaphosphate influencing phosphate uptake. There were 120 seedlings per treatment using soil from one of the laboratory plots which was known to be deficient in available phosphates.

After 19 days' growth, alternate wheat seedlings were cut at ground level for analysis and at 40 days, when the plants were almost 1 ft. high, further alternate plants were similarly sampled and analysed. All the treatments gave much better growth of wheat than the control rows and the guard rows gave intermediate growth. Analyses of 19-day shoots showed that wheat, having access to enriched soil with all three manners of placement of both triplesupers and sodaphosphate, contained two to three times as much contained phosphate based on oven-dry-matter, than the growth in the untreated soil. Again, the mean absolute amounts of phosphate per seedling of the more vigorously growing fertilized plants were about three to three and a half times as much. After 40 days' growth, the relative differences as shown by analyses, were less pronounced, the dry matter of the fertilized wheat containing only about half as much again of phosphate than the controls. This showed that the fertilized seedlings took up much of their extra phosphate during the very early period of growth. This trial showed about similar good early uptake from both triplesupers and sodaphosphate after 19 days of growth. Analyses after 40 days' growth showed higher, further uptake by the plants fertilized with sodaphosphate, thus confirming earlier work that this non-water-soluble fertilizer, when added to a known phosphate-fixing soil, has a higher later availability to plants. Detailed analytical data for this and other similar trials will be published later.

Numerous earlier pot culture trials and those mentioned above have shown that, when thoroughly mixed with the soil, including such placement applications, the "early" uptake of essential nutrient from mainly "citric-soluble" sodaphosphate was about the same as for "water-soluble" superphosphate and triplesupers. Again, there was evidence that sodaphosphate had a relatively greater "later" availability. Thus, over a season's growth, one might expect it to be a very suitable form of phosphatic fertilizer to use with many local soils which readily fix added water-soluble phosphates. On the other hand, in many cases, statistical field experiments with cereals, using a similar ribbon placement for both classes of fertilizers, have shown that the response was definitely less with sodaphosphate. One possible explanation of this apparent discrepancy shown by pot culture work and field experiments, is that the common manner of placing the two different kinds of phosphatic fertilizers may have favoured triplesupers, whereas for a true comparative valuation, it is necessary to use the optimum method of placement in each case. One factor which may have reduced the availability of sodaphosphate when applied as a locally concentrated ribbon application under field conditions is that the contained free sodium carbonate, and to a lesser extent, the basic nature of sodaphosphate, would result in the formation of alkaline soil conditions in the zone of enriched soil with a resultant lower availability of the fertilizer. This factor and the possible need for diluting this particular alkaline material with ample soil in placement applications was tested by a further series of pot culture trials.

It will have been noted that in pot culture trials when sodaphosphate was found to be very suitable, the material was adequately diluted with about 200 parts of soil (i.e. 0.1 per cent added  $P_2O_5$ ), whereas when applied with the drill, the local concentration would be very much higher.



Wheat seedlings were grown in soil to which had been added and thoroughly mixed, .1, .25, .5, 1.0, 2.5 and 5.0 parts of total  $P_2O_5$  or .44 to 22 parts of this fertilizer per 100 parts of soil. This range of ratios would include those obtained in the field. Other comparative trials were arranged, using similar amounts of added total phosphoric oxide in the form of triplesupers. Slight scorching started when the dressing of sodaphosphate used, containing 2.8 per cent of free sodium carbonate, reached one part per 20 to 30 parts of soil, and with higher concentrations growth was reduced. The analyses of 40 seedlings per treatment after 18 days' growth gave some very instructive information. When sodaphosphate was mixed with the soil up to a concentration of .5 per cent added  $P_2O_5$  (2.2 per cent added sodaphosphate), the uptake of phosphate was always greater than for triplesupers, whereas with increasingly higher concentrations in the same mass of soil, there was a continued fall in the uptake by the roots. When alkaline conditions and the formation of some sodium clay were brought about by the use of sodaphosphate, the uptake of phosphate by the roots in this new induced soil environment was reduced in spite of heavier applications. Under the conditions of the field placement of sodaphosphate, much of the added fertilizer would not be sufficiently dispersed, such that the small mass of soil in which it is contained would become alkaline when one might expect that the phosphate availability would be greatly reduced. This observation also offers a possible explanation of several instances when statistical field trials showed smaller absolute responses being obtained from double dressings than from single dressings of this material. On the other hand, the extra uptake by 40 seedlings following the use of triplesupers continued to increase without any check up to the highest concentration used.

The next obvious step in a scheme of work whereby any pot culture studies can offer clues to proper field experimentation is to find out the necessary dispersion of placed sodaphosphate so as to give optimum conditions for the maximum uptake of essential nutrient by growing crops.

#### *Available Soil Nitrogen*

In any work on the seasonal supply of available soil nitrogen, it is necessary to know what quantities reach the soil in the rainfall. Owing to frequent contamination by wind-blown soil and, more especially, by foreign nitrogenous organic matter, it was found necessary to collect adequate samples of rain by means of large glass funnels and glass containers which were washed daily and also to screen these vessels so as to reduce aerial contamination. Daily samples of rainfall of over .05 of an inch for the period 4th March to the 29th June, comprising twenty-two individual samples and representing rainfalls ranging from .06 of an inch to a maximum of 1.42 inches, were analysed for ammoniacal and nitrate nitrogen. Ammoniacal nitrogen only was also determined for a further thirty-four daily falls of rain up to the end of the year. There were fairly wide fluctuations in the apparent ammoniacal and nitrate contents of different falls of rain and occasionally there were some very high values which could be explained by the presence of visible contamination by wind-blown foreign matter. In one instance, an abnormally high value for ammoniacal nitrogen was undoubtedly due to the top-dressing of an adjoining plot with sulphate of ammonia. After allowing for cases when high values were believed to be associated with contamination by wind-blown particles, the values obtained for samples of rain-water analysed on the following day contained between .2 and .6 ppm ammoniacal nitrogen and .2 to .4 ppm nitrate nitrogen. The calculated mean amounts were .35 ppm and .3 ppm respectively, giving a total mean value of .65 ppm total nitrogen. Calculation shows that the soil received an average of about .15 lb. total nitrogen per acre per inch of rainfall. Thus, during 1949, with an abnormally low rainfall of 22.16 inches, the atmospheric contribution to soil nitrogen was of the order of 3.3 lb. per acre. Owing to the difficulty of collecting uncontaminated samples of rainfall and the analytical error involved in estimating minute amounts of these constituents, these values can only be approximate, but it can be said

that these initial estimations suggest that the mean annual gain in soil nitrogen from this source at the Scott Agricultural Laboratories is not more than some 6 lb. nitrogen per acre.

Some work was started on the sampling technique necessary for the determination of the seasonal ammoniacal and nitrate nitrogen contents of soils under six different vegetal covers at the Scott Agricultural Laboratories. Accurate soil samples for analyses were taken to a depth of 6 in. by means of three sampling tubes driven into the then dry soil at 6 in. apart. This method of sampling was repeated on three similar sites 10 ft. apart to give triplicate samples per plot. It was found that there can be marked variations in both ammoniacal and nitrate contents for such samples even when taken in such close proximity. In soils under grass and crops with low amounts of the order of 2 to 4 ppm ammoniacal nitrogen and 4 to 10 ppm nitrate nitrogen, certain samples contained twice as much as others, whereas in the case of fallow land and recently manured land, individual sub-samples contained very much more nitrate nitrogen than the mean. It was found that for adequate sampling it was necessary to collect a bulk composite soil samples of about two kilogrammes, made up of at least twelve sub-samples.

### *Survey Work*

A reconnaissance survey was made of the Shikoosa region near Kakamega, to select a site for a new Provincial Investigation Station and a prison farm. The main soil type on the gentle slope, comprising about three-quarters of the area, is a medium to dark brown clayloam over a buff-yellow clayloam, with incipient murram formation at 4 to 5 ft., derived from old sedimentary deposits. Where there had been soil accumulation on more level land, there was a slightly greyish-black clayloam over the highly coloured subsoil. In the northern portion there was an admixture of granitic material from the higher ground. Analyses of profile samples of the main soil type showed that land which had been cleared of virgin forest some fifty years ago and which was now carrying an old-established secondary vegetation of tall, coarse grasses and *Combretum*, had higher reserves of humus and soil bases and a better soil structure than similar land still under virgin forest. The soils present were only representative of some of the less extensive types of Nyanza, thus limiting the suitability of the area as an experimental station for the Province, but otherwise the site is very suitable.

A rapid survey was also made over an area of some 10,000 acres to the north of Karatina to study the suitability of the area for tea-growing by Africans. It was possible to select adequate acreages of deep, naturally well-drained soils with suitable physical and chemical properties for the successful growth of this crop.

A report was made on 45 soil samples taken by the Pasture Research Officer in connexion with an ecological survey of certain lands at the Coast. Particular soil studies were made in the Sagana and Machakos districts.

### *The Composition of Plant Materials*

A record of the composition of local plant products analysed in the laboratory is being built up. Further analyses of everlasting pea hay (*Lathyrus latifolius*) showed that this drought-resisting plant, which is often used to bind narrow-base terraces, has a high feeding value. A range of samples taken at stages of growth varying from lush young growth to mature, showed that the dried material contained 29 per cent to 20 per cent crude protein; 4 per cent to 3 per cent oil with 20 per cent to 28 per cent crude fibre and a high ash content. With a fairly mature material, some 55 per cent of the green weight could readily be expressed as a juice, which, on dehydration, contained as much as 33 per cent to 35 per cent crude protein. A similar juice obtained from common-occurring pig weed (*Amaranthus* spp.) contained 33 per cent crude protein. A very dense tall growth of an indigenous legume, *Vigna heterophylla* Rich. growing on wetland in



the Kitale district gave a hay with 9 per cent crude protein and 23 per cent crude fibre. Meal prepared from sunflower head with seed contained 11 per cent crude protein and that from the head, after removal of the seed, 5 per cent only crude protein. Another interesting analysis was coffee pulp silage prepared at the Coffee Research Station, Ruiru. The dried material based on 10 per cent moisture, contained 9 per cent crude protein, 2 per cent oil, 27 per cent crude fibre and 44 per cent N-free extract, the latter being high in sugars. Analyses were carried out of the inner and outer portions of the root of Wild Abyssinian Banana (*Musa ensete*). The portion within the cambium layer, after drying, contained 17 per cent crude protein with 4 per cent only crude fibre, whereas the outer portion contained 7 per cent crude protein and 16 per cent crude fibre. From the dried inner root portion it was possible to extract 35 per cent by weight of starch. A dozen analyses of lucerne showed a crude protein content varying between 16 per cent and 23 per cent, depending mainly on the stage of growth when cut.

#### Report of Mr. J. Hopkins, Agricultural Chemist (Pyrethrum)

Investigational work was carried out early in the year involving a modification to the Seil method of analysis. This method is based on the fact that chrysanthemum monocarboxylic acid, which represents Pyrethrin I, is volatile in steam, whilst the dicarboxylic acid, representing Pyrethrin II, is non-volatile. In the official method steam is injected into the solution of the mixed acids during distillation and the volatile acid carried over and recovered by condensation. It has always been noticed that the Seil method gives appreciably lower results than the Wilcoxon-Holladay method, which latter is based upon a specific reaction for Pyrethrin I, and it has been suggested that this may be due to partial decomposition of the acids caused by the injection of steam. Accordingly, a number of analyses were carried out using a modified apparatus in which the solution containing the mixed acids was gently boiled without steam being injected but water added from time to time in order to ensure that sufficient distillate was collected to contain all the volatile acid. At the same time, parallel determinations were made by the official method in which the injection of steam was maintained. It was found that a higher result was obtained by the modified method in which no steam was used. Some typical comparative results are given in Table I.

TABLE I

| Sample      | Method            | Py. I | Py. II | Total |
|-------------|-------------------|-------|--------|-------|
|             |                   | %     | %      | %     |
| A/53 ..     | Normal Seil .. .. | 0.66  | 0.56   | 1.22  |
|             | Modified .. ..    | 0.71  | 0.60   | 1.31  |
| 15 ..       | Normal Seil .. .. | 1.63  | 1.27   | 2.90  |
|             | Modified .. ..    | 1.71  | 1.31   | 3.02  |
| PY/A. 54 .. | Normal Seil .. .. | 0.56  | 0.57   | 1.13  |
|             | Modified .. ..    | 0.60  | 0.58   | 1.18  |

This modification, not being in accordance with the official published method, could not be applied to commercial analyses, but is a further indication of the generally unsatisfactory nature of the Seil method, and it is worthy of note that as a result of similar work by a number of investigators, it had been decided that the Wilcoxon-Holladay Method shall be adopted in 1950 as the standard method on both sides of the Atlantic.

Some work was carried out on the extraction of the pyrethrins with cold solvent as compared with the normal method of Soxhlet extraction in which the solvent is boiled. Fifty grammes of ground pyrethrum flowers were packed fairly tightly into a glass column about one inch in diameter and the solvent allowed to percolate very slowly through the column until the percolate was colourless, the whole process taking 18 to 20 hours. It was found that with fresh material results were practically identical with those obtained by hot extraction, but that with aged material, in which considerable oxidation could be expected to have taken place, cold extraction tended to give appreciably lower results. This indicates that whereas oxidation products of the pyrethrins are soluble in hot solvents, they are considerably less so in the cold and that results obtained by hot extraction of pyrethrum that has been stored for any length of time are likely to be falsely high. Unfortunately, no facilities exist at these laboratories for biological assay work but it has been shown by other investigators that oxidized pyrethrins have no insecticidal properties. Some typical results are given below.

TABLE II.—COMPARISON OF HOT AND COLD EXTRACTION

| Material           | TOTAL PYRETHRINS |             |                 |             |
|--------------------|------------------|-------------|-----------------|-------------|
|                    | Hot Extraction   |             | Cold Extraction |             |
|                    | AOAC Method      | Seil Method | AOAC Method     | Seil Method |
| Achenes .. ..      | 1.39             | 1.36        | 1.36            | 1.29        |
| 2 years old .. ..  | —                | 1.38        | —               | 1.26        |
| 1944 Flowers .. .. | 1.08             | —           | 0.99            | —           |
| 1946 Flowers .. .. | 1.20             | —           | 1.16            | —           |
| 1949 Flowers .. .. | —                | 1.14        | —               | 1.12        |
| 1949 Flowers .. .. | 1.30             | 1.27        | 1.29            | 1.27        |

A system has been established whereby consignments of Kenya pyrethrum arriving in New York are immediately sampled and a representative sample sealed in a special container and returned to Kenya by air mail. This has enabled some very accurate estimates of the depreciation of pyrethrin content during transit to be computed. Identical samples are also analysed in New York and it is gratifying to note that, with the standardization of methods now obtaining, complete agreement between analyses carried out in New York and at these laboratories are usual. It has been also possible to show that unsatisfactory shipping conditions, such as obtain when a consignment is carried in one of the hotter holds of a ship, definitely cause accelerated deterioration.

TABLE III.—DEPRECIATION DURING TRANSIT

| Sample | TOTAL PYRETHRINS |                 | Loss on Original | Period in Days | Hold Conditions |
|--------|------------------|-----------------|------------------|----------------|-----------------|
|        | Original Content | Present Content |                  |                |                 |
| 287    | %<br>1.82        | %<br>1.56       | %<br>14.3        | 140            | Normal          |
| 312    | 1.73             | 1.52            | 12.1             | 68             | "               |
| 310    | 1.84             | 1.60            | 13.1             | 111            | "               |
| 289    | 1.64             | 1.32            | 19.5             | 87             | Hot             |
| 307    | 1.74             | 1.39            | 20.1             | 102            | Hot             |
| 308    | 1.60             | 1.38            | 13.7             | 76             | Normal          |
| 314    | 1.79             | 1.41            | 21.2             | 90             | Hot             |



At the request of the Agricultural Officer (Pyrethrum), some work was done involving the estimation of trace elements, notably magnesium and manganese, in pyrethrum flowers in order to determine whether treatment of the living plant with these elements had any effect upon the ultimate pyrethrin content of the flowers. It was found, however, that the content of magnesium, calcium and manganese could not be correlated with the pyrethrin content and that treatment of the plants with these elements did not have any noticeable effect upon the pyrethrin content of the flowers produced.

G. H. GETHIN JONES,  
*Senior Soil Chemist.*

# ANNUAL REPORT OF THE SENIOR PLANT BREEDER, 1949

## The Wheat Season—General

The season started well, after three dry months, with satisfactory rains in April, May, June, July and August were all below average followed by a rather wetter September than usual. The year's total rainfall on the Plant Breeding Station amounted to 29.42 in., 6 in. below average.

In spite of the dry year wheat yields have been good and a heavy harvest has been reaped in most areas.

Figures of rainfall recorded on this station were:—

| Month             | 1949<br>Inches | 20 years' average<br>Inches |
|-------------------|----------------|-----------------------------|
| January .. .. .   | 0.03           | 0.82                        |
| February .. .. .  | 0.85           | 1.28                        |
| March .. .. .     | 0.57           | 2.67                        |
| April .. .. .     | 4.97           | 4.36                        |
| May .. .. .       | 3.21           | 4.14                        |
| June .. .. .      | 3.20           | 3.75                        |
| July .. .. .      | 3.91           | 4.90                        |
| August .. .. .    | 4.37           | 4.93                        |
| September .. .. . | 4.15           | 2.35                        |
| October .. .. .   | 0.82           | 1.73                        |
| November .. .. .  | 1.26           | 2.53                        |
| December .. .. .  | 2.08           | 1.79                        |
| Total ..          | 29.42          | 35.25                       |

### Review of Main Wheat Varieties Grown

The main varieties grown in the Colony during the season were Regent 975.6, Equator, 294.M, Sabanero and 117.A in decreasing order of importance.

The considerable increase in the acreage sown to Regent is due to its good yielding powers, strong straw and popularity with the mills. However, its susceptibility to yellow ear rust and damage from this cause as low as 7,500 ft., as explained later in the report, will probably lead to some reduction in the acreage sown to Regent during the coming season.

Equator is still the mainstay of the high wheat areas on account of its yellow ear rust resistance. It is, however, weak in the straw and of poor baking quality and too much is not liked by the mills. Attempts are being made to produce new varieties to replace Equator in the upper wheat areas. Equator II, a single plant selection from the parent variety made to purify the strain, and released to farmers in 1946, is now so mixed that no crop of this strain was passed for seed purposes; and growers will have to sow the mixed crop until a new purified strain can once more be made available.

294.M, described in the Annual Report for 1947 and released to farmers for sowing in 1948, has rapidly gained favour with growers and now ranks as the third most important wheat in the Colony. It has yielded well in Kenya over a variety of soils, altitudes and rainfall conditions; it is resistant to leaf rust and is resistant, in seedling tests, to the eight physiologic stem rust forms (preliminary tests suggested a border-line reaction to K8) and may fairly be said to mark a substantial advance in wheat breeding in Kenya. 294.M is of "filler-class" baking quality; and crosses, designed to raise the quality of this variety whilst preserving its good agronomic characteristics, were made in 1944 and 1945.

Sabanero and 117.A are still grown in the medium and lower wheat areas but are gradually declining in acreage and importance in favour of newer, stronger straws and better yielding hybrids. Rhodesian Sabanero, from a single plant selection made in Southern Rhodesia, is a uniform strain which has yielded



better in the variety trials than the unselected crop. It is recommended to farmers in place of the somewhat mixed parent strain. A certain quantity of Sabanero is required by the mills since, in spite of its poor baking quality, this variety possesses the property of distensibility which is lacking in most Kenya-bred hybrids.

Other wheats which, although not rust resistant, are still grown to a limited extent in certain districts include Kenya Governor, D.C. × Ceres, Burbank, Reward, N.B. 230 and K.T.I.

#### *Rust and other Diseases*

Little black stem rust, *Puccinia graminis tritici*, was reported during the season. Variety 294.B, which had proved fully resistant in seedling tests, rusted on one farm of the Uasin Gishu Plateau, and the rust form proved to be K1.

Both leaf rust, *P. triticea*, and yellow ear rust, *P. glumarum*, were little in evidence except in the case of Regent 975.6. This hard red Canadian spring wheat, of good baking quality, had done well in Kenya since its release to farmers in 1946 and had shown itself resistant to yellow ear rust up to 8,500 ft. in the Colony. It was, however, known in seedling tests to be susceptible to three physiologic forms of black stem rust, K6, K7 and K8. During the season Regent was unexpectedly attacked and damaged, not by stem rust, but by yellow ear rust as low as 7,500 ft.; and this variety will in future have to be kept below this altitude.

Take-all, *Ophiobolus graminis*, was more widespread than usual and caused quite severe damage on some farms over 8,000 ft.

Some glume blotch, *Septoria nodorum*, and *Fusarium* root rot were seen but did inappreciable damage.

#### *Physiologic Forms of Black Stem Rust*

The new physiologic form of black stem rust, K8, reported last season in the Annual Report of the Senior Plant Breeder, was not found in the field in Kenya.

Seedling tests show Kenya Governor, 291.J.1.I.1, 294.M.7.C.6.A, 318.AJ.4.A.1, 261.R.7.C.1.B, Kenya Ploughman (318.O.3.B.2) and Kenya Settler (294.M.7.C.1.C) to be resistant, Equator and 294.B.2.A.3 to have border-line reactions and 117.A, Sabanero, Regent 975.6 and 192.Q.2.A.L to be susceptible.

The form K8 shows susceptible reactions on the testers Einkorn, 112.A and B.256.G. For reference purposes a table is given showing the reactions of the various rust testers to the eight physiologic forms so far identified in the Colony:—

|                        | K1 | K2 | K3 | K4 | K5 | K6 | K7 | K8 |
|------------------------|----|----|----|----|----|----|----|----|
| Kenya Governor .. .. . | S  | R  | S  | S  | S  | R  | R  | R  |
| Einkorn .. .. .        | R  | S  | R  | R  | R  | R  | S  | S  |
| 112.A .. .. .          | R  | S  | R  | R  | S  | R  | S  | S  |
| Reliance .. .. .       | R  | R  | S  | R  | R  | S  | S  | R  |
| B.256.G .. .. .        | R  | R  | R  | S  | S  | R  | R  | S  |
| 58.F (L.I) .. .. .     | R  | R  | R  | R  | S  | R  | R  | R  |

For the first time since its release in 1945, 291.J.1.I.1 was attacked by stem rust on the Plant Breeding Station and the appearance of a 9th physiologic form is suspected. This is still the subject of test.

#### **Releases of New Wheats**

Three new wheats were released to farmers from departmental control for sowing in 1950. The following description of these varieties was published in the local Press:—

*Kenya Settler—Wheat No. 294.M.7.C.1.C.*—A selection out of the cross Australian 26.A × 117.A, bred and selected at Njoro.

It is a beardless, white-chaffed, white-grained wheat possessing fair straw strength and medium length maturity, equal roughly to 117.A, and taking approximately  $5\frac{1}{4}$ - $5\frac{1}{2}$  months at Njoro, 7,100 ft. It has full resistance to the eight biologic forms of black stem rust occurring in the Colony; possesses appreciable resistance to leaf rust and is resistant to yellow ear rust up to 8,000 ft. in Kenya.

This wheat is similar to 294.M.7.C.6.A, out of the same cross and released in 1948, and is a week to 10 days later in maturity. It has done well in large-scale trials in the Solai area of Kenya and should be suited to all areas in the Colony in which 294.M.7.C.6.A is successful, i.e. 6,000-8,000 ft. approximately, having a growing season of 5-6 months' duration.

*Kenya Ploughman—Wheat No. 318.O.3.B.2.*—A selection out of the cross (D.C.  $\times$  Ceres 721)  $\times$  112.E.8.L.5 bred and selected at Njoro.

It is a beardless, white-chaffed, white-grained wheat of fair straw strength maturing in approximately  $5\frac{3}{4}$ -6 months at Njoro, 7,100 ft. It has full resistance to the eight biologic forms of black stem rust occurring in the Colony, is fairly resistant to leaf rust and to yellow rust up to approximately 8,500 ft. in Kenya.

This wheat is similar to 318.AJ.4.A.1, out of the same cross and released in 1949, but is suited to slightly higher areas. It has done well in the Ol Kalou and Ol Joro Orok areas of Kenya and should be suited to all areas in the Colony from 7,500-8,500 ft. having a growing season of six months duration.

291.J.1.I.1 (*Pure or Regenerated*)—291.J, *Mark II.*—A single plant selection from 291.J.1.I.1, made to purify the variety. It has straw strength, maturity and grain quality equal to the parent strain and is suitable for all areas in Kenya in which 291.J.1.I.1 grows successfully.

This selection should provide a source of pure seed for farmers wishing to renew their stocks of this variety.

#### **New Wheats under Multiplication with Farmers**

The following wheats were increased by farmers during the season under departmental control. The numbers of bags of each reaped is given in brackets.

338.AC.2.E.1 (400 *bags*).—This cross was described in the 1948 Annual Report. It was then intended to release it to farmers at the end of the 1949 season if it continued to yield satisfactorily on a field scale. This has, in fact been the case; but it seems as if the sister strain AA.1.A.2, of comparable yielding powers, has somewhat better baking characteristics. In view of this it has been decided to proceed with the multiplication of AA.1.A.2 and to leave the release of AC.2.E.1 in abeyance for the time being.

321.BT.1.B.1 (200 *bags*).—A selection from the cross Australian 45.C.5  $\times$  117.A, bred to replace 117.A in the medium and lower wheat-growing areas.

In view of its poor yield on a field scale during the season it is intended to give it a further year's trial before deciding on its future.

294.H.2.A.1 (1,500 *bags*).—This early maturing selection from the cross Australian 26.A  $\times$  117.A continued to yield satisfactorily on a field scale. It appears, however, to possess no advantages over the quick maturing sister strain, B.2.A.3, released to farmers in 1948 and hence will not be released for the time being.

360.H (350 *bags*).—A selection from the cross 294.M.7.C.6.C  $\times$  184.P.2.A.1.E. This wheat has yielded satisfactorily on a field scale during the past season; and it will be further tested and increased during the coming year for possible release from departmental control.



291.J.1.1.1.1 (550 bags).—This bearded selection from the parent 291 strain will be tested for a further season before its future is decided. It appears to possess no advantages over 291.J.1.1.1 except the awns which are not regarded as an altogether unmixed blessing.

337.BE.2.F.2 (400 bags).—This wheat has yielded consistently well at Molo over three years and at Ol Joro Orok over two years. A further season's increase should give sufficient seed for release to farmers. 337, a cross between 223.F.1.A.3 × 291.J.1.B.1, has shorter and better straw than Equator and is about one month earlier in maturity.

It is of moderate baking quality.

341.F.2.D.1 and 350.AD.9.C.2.—These two wheats, mentioned in the 1948 Report, will be further tested during the coming season.

*Other Wheats.*—Further wheats under test and multiplication include: 355.AZ.1 (117.A × 291.J.1.1.1); 351.AS.1.B.2 (117.A × Regent 975.6); a white-grained selection out of 117.A; R.64, a selection out of D.C. × Ceres 721; Newthatch, C.I.12318 and a durum wheat Carleton, C.I.12064, both from the U.S.A. Department of Agriculture, Beltsville, Maryland. Newthatch is known to be susceptible in seedling tests to K6, K7 and possibly K8, and will be unlikely to be released to farmers for this reason. It possesses the property of distensibility and is already being used in crosses designed to introduce this quality into Kenya-bred hybrids.

D.C. × Ceres 721.—Of the four rust resistant selections of this variety reported last season as having reached the bag stage, one, R64, has been increased to 10 bags by a local farmer.

#### **Wheat Breeding at the Plant Breeding Station, Njoro, 7,100 ft., and the Rongai Sub-station, 6,000 ft.**

Selected segregates from the crosses 354 (Warigo × Sterling), 357 (184.P.2.A.I.E × 294.AN.4.A.1), 359 (291.J.1.1.1 × 184.P.2.A.1.E) and 360 (294.M.7.C.6.C × 184.P.2.A.1.E) were multiplied during the season.

Crosses 352, 353 and 355 have been discarded for stem rust or glume blotch susceptibility (*see* Cage Material).

#### **1948 Importations**

*From Professor Waterhouse, Sydney, New South Wales.*—The 13 hybrids, chiefly of Australian × Kenya wheat crosses, selected from the 1948 tests were given a further trial. Most had to be discarded for weak straw and stem rust susceptibility. The following two are to be carried on for further tests in 1950: W1404 (Dundee × Kenya 745), W1534 (Geeralying × Kenya 745).

*From the Central Experimental Farm, Ottawa, Canada.*—Both Saunders C.A.N. 3516 and Cascade C.A.N. 3593 remained free of stem rust.

*From the Department of Agriculture, Victoria, Australia.*—Diadem had short stiff straw and good ears. It was only slightly attacked by stem rust on late tillers.

*From Dr. C. H. Goulden, Winnipeg, Manitoba, Canada.*—Redman, C.A.N. 3633, had fair straw and remained free of stem rust.

*From the State of Arizona, U.S.A.*—Marfed, C.I.11919, was somewhat rusted with pustules of the "S" type.

*From the Economic Botanist, New Delhi, India.*—Eighteen durum wheats were under test in 1948. Five of these were carried on to multiplication plots during the present season, L.D. Nos. 101, 104, 111, 119 and 128. All remained free of stem rust and stood up well to the dry conditions.

All these wheats will be given a further trial, on an extended scale, during the coming season.

### Yields of Some Newer Hybrids

The following table gives yields of some of the newer hybrids at Njoro, 7,100 ft., and at Rongai, 6,000 ft., over a period of two years.

| Variety               | Njoro |      | Rongai |      |
|-----------------------|-------|------|--------|------|
|                       | 1948  | 1949 | 1948   | 1949 |
| 294.M.7.C.1.C ..      | 12.8  | 10.4 | —      | —    |
| 291.J.1.1.1.1 ..      | 12.3  | 9.4  | —      | 6.9  |
| 318.AJ.4.A.1 ..       | 11.9  | —    | —      | —    |
| 294.M.7.C.6.A ..      | 11.5  | 11.1 | —      | —    |
| 321.AO.1.C.3 ..       | 11.3  | —    | —      | —    |
| 360.H .. ..           | 11.3  | 11.3 | —      | 6.8  |
| 291.J.1.1.1 (Sel.) .. | 11.1  | 8.2  | —      | —    |
| Sabanero Rhodesia     | 11.0  | 11.1 | —      | —    |
| 261.R.7.C.1.B ..      | 10.9  | —    | 5.0    | —    |
| 294.H.2.A.1 ..        | 10.8  | —    | 5.5    | —    |
| Newthatch ..          | 10.8  | —    | —      | 4.0  |
| 294.H.2.A.1 (Sel.)    | 10.6  | —    | —      | —    |
| 291.J.1.1.1 ..        | 10.4  | —    | 8.5    | 7.1  |
| 318.O.3.B.2 ..        | 10.2  | —    | —      | —    |
| 294.B.2.A.3 ..        | 10.0  | —    | 5.8    | —    |
| 321.BT.1.B.1 ..       | 9.1   | 7.3  | —      | 5.9  |
| 117.A (Sel.) ..       | 9.0   | —    | 8.4    | 6.8  |
| Sabanero ..           | 8.8   | —    | —      | —    |
| 117.A .. ..           | 8.7   | —    | —      | —    |
| 184.P.2.A.1.A ..      | —     | —    | —      | 6.1  |
| 351.AS.1.B.2 ..       | —     | 8.6  | —      | 6.0  |
| 355.AZ.1 ..           | —     | 7.0  | —      | 5.9  |
| 338.AO.2.B.5 ..       | —     | 7.5  | —      | 5.6  |
| 338.AA.1.A.2 ..       | —     | 6.3  | —      | 5.6  |
| Carleton .. ..        | —     | 6.3  | —      | 3.6  |
| P.05 .. ..            | 1.0   | 1.0  | 1.2    | 0.9  |
| P.01 .. ..            | 1.3   | 1.3  | 1.6    | 1.2  |

Yields given in bags of 200 lb. per acre.

It is of interest to note that most of the newer wheats have kept up their yields over the two-year period.

### Cage Material

Selected material from crosses 354, 356 and 360, which has reached apparent fixity, will be moved from the cage to the multiplication plots in 1950.

The crosses 363, 364, 365 and 367, described in the 1948 Annual Report, are now in F.3. Selection has again been continued for resistance to leaf rust combined with good straw and baking quality. The Australian parent, Warigo, used in a number of crosses for its resistance to leaf rust has proved extremely susceptible to glume blotch, *Septoria nodorum*, and the crosses 352, 353 and 366 have been discarded on this account. Cross 355 (117.A × 291.J.1.1.1) has been discarded since all the progeny, in F.4, were attacked by stem rust. This lends support to the view, mentioned earlier, that a new physiologic form K9 of stem rust has appeared. 355.AZ.1, at present under multiplication, has not so far rusted in the field but its future would now appear to be doubtful.

F.1's of the crosses 372-392 have advanced to F.2.

The following new crosses were sown in the cage:—

Cross 372—Newthatch × 184.P.2.A.1.E.

Cross 373—Newthatch × 117.A.

Cross 374—Newthatch × 192.Q2.A.L.

Cross 375—Newthatch × 294.AI.5.G.2.



- Cross 376—Regent × Cobbs 1066.  
 Cross 377—Regent × 291.J.1.1.1.  
 Cross 378—Regent × Kenya Governor.  
 Cross 379—Regent × 261.S.10.C.2.D.  
 Cross 380—Regent × 261.R.7.C.1.B.  
 Cross 381—Regent × 184.P.2.A.1.E.  
 Cross 382—Regent × 294.A1.5.G.2.  
 Cross 383—Regent × Warigo.  
 Cross 384—Equator II × 318.O.3.B.2.  
 Cross 385—Equator II × 318.AJ.4.A.1.  
 Cross 386—Warigo × 192.Q.2.A.L.  
 Cross 387—291.J.1.1.1 × Kenya Governor.  
 Cross 388—291.J.1.1.1 × 294.A1.5.G.2.  
 Cross 389—291.J.1.1.1 × 261.R.7.C.1.B.  
 Cross 390—291.J.1.1.1 × 261.S.10.C.2.D.  
 Cross 391—291.J.1.1.1 × 261.R.7.C.2.  
 Cross 392—Newthatch × 294.AN.4.A.1.  
 Cross 393—(T. Timocum × Marquis) × Regent.  
 Cross 394—(T. Timocum × Marquis) × Regent.  
 Cross 395—(T. Timocum × Marquis) × Newthatch.  
 Cross 396—(T. Timocum × Marquis) × Newthatch.

*New Importations.*—The following wheats were under trial for the first time:—

*From Southern Rhodesia.*—Sixty-one varieties including 16 Kruger × Punjab 8A crosses, Kruger, Pioneer, Matopo, Gluyas, Droop, Baart, Klim, Excelsior, Rooi Else, Mentana, Quality, Beltista, Sterling and 14 Indian wheats, Cultures 39, 217, 226, 237, 249, 267, 268, Pusa 3, Pusa 4, Pusa 52, Punjab 8A, Punjab 14, Karachi and Lalkasarwali. The majority of these rusted, had weak straw or were unsatisfactory in other respects and will be discarded. A few of the Indian wheats, Pusa 3, 4, 52, Punjab 8A and C 249, will be kept as possible parents.

*From Potchefstroom, South Africa.*—Six T. vulgare × T. Timopheevi crosses 39W61-1, 39W73-1, 436-1-2-M-1, 3466-4-M-M-3, 361-M-4-1 and C 17-1-1-1.

The first three had weak straw, or rusted, and will be discarded: the final three were somewhat more promising and will be given a further trial. C 17-1-1-1 in particular has good straw and seems the best of the series.

*From the Ministry of Agriculture, Orman, Egypt.*—The varieties Beladi 116 (durum), Hindi 62, Hindi D, Mabrouk, Mukhtar and Giza. The first four were unsatisfactory and will be discarded; the last two will be tried again during the coming season.

*From the Dominion Laboratory of Cereal Breeding, University of Manitoba, Canada.*—Marquis × Agropyron elongatum R.L. Nos. 2150, 2183 and 2200; Bald Medeah × (Iumillo – Mindum) R.L.1742; R.L.1742 × Carleton<sup>2</sup>, R.L. Nos. 3047 and 3048; Chinese × (Chinese-A. elongatum) Perennial 400; R.L. 2265 × Redman<sup>2</sup>, R.L. 2327.5; Triticale R.L. 2388; Hope × Timstein R.L.2477; and R.L.2265 × Redman<sup>3</sup> R.L.2564. All were attacked by stem rust to a greater or lesser extent. They will be given a further trial during 1950.

*From the Department of Agriculture, Northern Rhodesia.*—Red Egypt, Red Klein, Knoppies, Farrertrou, Vorentoe, Scheepers and Sterling. All were badly attacked by stem rust and will be discarded.

### **Wheat Breeding at the High and Low Altitude Sub-stations**

*Scott Agricultural Laboratories, 5,700 ft.*

Cross No. 339, as foreshadowed last year, has been discarded owing to its susceptibility to K8.

Selected material from crosses Nos. 356 and 358 were advanced to the multiplication plots. Owing to the extremely dry conditions all wheats made poor growth making critical selection impossible.

The wheats will be grown at Njoro during 1950 for further test and to increase the seed for possible yield trials.

The aim of the low altitude breeding work is to produce quick maturing rust-proof wheats for the areas with two short seasons per year such as the areas east of the Rift and the Northern Province of Tanganyika.

*Molo Sub-station, 9,300 ft., and Ol Joro Orok, 7,800 ft.*

The aim of the high altitude breeding work is to produce a substitute to Equator, still the mainstay of these areas on account of its resistance to yellow ear rust.

It is, however, susceptible to stem rust, possesses weak straw and poor baking quality and is not a particularly high yielder.

Some results of yield trials carried out at Molo and Ol Joro Orok over the last three years with some of the new hybrids, which it is hoped may replace Equator, are given below. Although the altitude of Ol Joro Orok, east of the Rift, is 1,500 ft. lower than the Molo sub-station the climate is considerably colder and is more akin to altitudes of 1,000 ft. higher in the warmer areas, west of the Rift, in which Molo is situated.

Both 360.H and Kenya Ploughman (318.O.3.B.2) grew well and remained comparatively free of yellow ear rust during this season although under test at a considerably higher altitude, 1,300 ft. and 800 ft. respectively, than usually recommended. They will be further tested in a yield trial at 9,300 ft. during the coming season.

|              |    |  | <i>Molo</i> |      |      | <i>Ol Joro Orok</i> |      |
|--------------|----|--|-------------|------|------|---------------------|------|
|              |    |  | 1947        | 1948 | 1949 | 1948                | 1949 |
| 341.F.2.D.1  | .. |  | 13.3        | 8.7  | 11.8 | 7.7                 | 9.9  |
| 337.BE.2.F.2 | .. |  | 13.1        | 9.7  | 11.9 | —                   | 11.1 |
| 350.AD.9.C.2 | .. |  | 12.3        | 7.2  | 9.3  | —                   | 11.0 |
| 337.V.3.B.1  | .. |  | 10.5        | 9.1  | 12.9 | 6.4                 | 10.3 |
| 340.Y.4.A.1  | .. |  | 10.3        | —    | 11.6 | 6.4                 | 5.7  |
| 341.O.2.B.1  | .. |  | 9.6         | —    | 9.6  | 6.5                 | 8.7  |
| Equator II   | .. |  | 8.9         | 9.1  | 9.6  | 4.3                 | 6.2  |
| 350.AD.9.B.1 | .. |  | 7.1         | —    | —    | 5.9                 | —    |
| 337.V.1.B.1  | .. |  | 4.9         | —    | 11.3 | 8.2                 | 4.1* |
| 337.V.3.A.2  | .. |  | 2.9         | —    | —    | 5.5                 | —    |
| 337.V.3.A.1  | .. |  | 1.4         | —    | —    | 4.2                 | —    |
| 337.AB.2.B.1 | .. |  | —           | 8.6  | —    | —                   | —    |
| 337.V.2.B.1  | .. |  | —           | 8.3  | —    | —                   | —    |
| 337.C.2.A.2  | .. |  | —           | 7.9  | —    | —                   | —    |
| 337.V.2.B.3  | .. |  | —           | 7.1  | —    | —                   | —    |
| 337.C.2.A.3  | .. |  | —           | 7.0  | —    | —                   | —    |
| 337.AA.1.A.3 | .. |  | —           | 6.7  | —    | —                   | —    |
| 337.AE.2.B.2 | .. |  | —           | 5.8  | —    | —                   | —    |
| 341.F.2.D.2  | .. |  | —           | —    | 11.9 | —                   | 11.2 |
| 350.AJ.3.A.2 | .. |  | —           | —    | —    | —                   | 6.9  |
| 344.AD.3.A.1 | .. |  | —           | —    | —    | —                   | 6.3  |
| 340.Y.4.A.4  | .. |  | —           | —    | 11.7 | —                   | —    |
| 318.O.3.B.2  | .. |  | —           | —    | 10.8 | —                   | —    |
| 350.AR.4.A.2 | .. |  | —           | —    | 10.0 | —                   | —    |
| P.05         | .. |  | 1.9         | 2.0  | 1.5  | 1.1                 | 1.2  |
| P.01         | .. |  | 2.5         | 2.5  | 1.9  | 1.5                 | 1.6  |

\* 337.V.1.B.1 had low yield due to damaged seed and poor germination.

Yields given in bags of 200 lb. per acre.



### Baking Quality and Fermentation Tests

Samples of all advanced hybrid material undergoing multiplication for possible release to farmers is sent, by the courtesy of the millers, Messrs. Unga, Ltd., Nairobi, to Dr. Kent Jones for a test of baking quality.

In addition, Pelschenke Wholemeal Fermentation Tests are carried out as a routine measure on all new hybrids. These tests serve as a guide to quality in the early stages of selection when material is very limited in amount.

### Wheat Rate of Seeding Trials

These trials were continued by the Agricultural Officers concerned at the three centres, Eldoret, Kitale and Ol Joro Orok. The object of the trials is to determine the lowest seeding rates which will give satisfactory crops. The varieties used were the same as in 1948, i.e. 294.B at Eldoret, 261.R at Kitale and D.C. x Ceres at Ol Joro Orok. The two seasons' results are given in the following table.

Where seeding rates applied differed materially from those required the actual figure is given in brackets. Fertilizer was applied at the rates obtaining in each particular district.

| Seeding Rate | Njoro    |           | Eldoret |      | Kitale | Ol Joro Orok |       |
|--------------|----------|-----------|---------|------|--------|--------------|-------|
| lb./acre     | 1948     | 1948      | 1949    | 1949 | 1948   | 1949         |       |
| 30 .. ..     | Not sown | 4.8       | 7.8     | 9.5  | 9.3    | 9.3          | (31)  |
| 50 .. ..     | 13.7     | 4.8 (45)  | 8.3     | 10.3 | 9.5    | 9.5          | (47)  |
| 70 .. ..     | 13.9     | 5.2 (56)  | 8.8     | 12.0 | 9.3    | 9.3          | (70)  |
| 90 .. ..     | 14.4     | 5.2 (81)  | 9.1     | 11.2 | 9.6    | 9.7          | (93)  |
| 110 .. ..    | 14.4     | 5.5 (95)  | 9.8     | 11.2 | 9.9    | 9.9          | (109) |
| 130 .. ..    | 14.4     | 5.3 (130) | 9.4     | 11.3 | 9.4    | 10.4         | (128) |
| 150 .. ..    | 14.6     | 5.3 (141) | 9.4     | 11.3 | 9.8    | 8.8          | (153) |
| P.05 .. ..   | Not      | 0.5       | 0.4     | 0.7  | Not    | Not          |       |
| P.01 .. ..   | Sig      | 0.7       | 0.5     | 0.9  | Sig    | Sig          |       |

Yields given in bags of 200 lb. per acre.

Plots were in all cases one-fifth acre and four replications were laid down in a randomized block trial except the 1949 Ol Joro Orok trial which consisted of two replications only.

It would seem from the small number of experiments so far carried out that there is little difference in yields of wheat over a wide range of sowing rates. From observations it is known that the heavier sowings are later in ripening and tend to lodge more than the lighter sowings. Both years have been marked by the absence of heavy storms as the crop was ripening. Lodging in the heavier seedings would be accentuated in a wet year.

These trials will be carried on for a further period to smooth out seasonal effects.

### Barley

#### New Varieties

Research, a two-row variety received from the State Research Farm, Victoria, Australia, released to farmers from departmental control in 1948, continued to yield well on a field scale. This variety took first prize in 1949 in the Malting Barley Competition organized by the East African Breweries, Ltd. It has proved resistant to yellow rust up to 8,000 ft. and over and is undoubtedly a most valuable addition to Kenya's barleys.

Glacier, C.I. 6976, a six-row feeding barley from the United States, which had done well in preliminary trials, was released to farmers during 1949. This season it was attacked and severely damaged by yellow rust at Ol Joro Orok at 7,800 ft.

and it seems likely that the cultivation of this variety will have to be kept below 7,000 ft. Its good yielding powers and strong straw make it a useful feeding barley for the lower altitudes.

#### *Release of a New Variety*

Mariout, a six-row variety received from Southern Rhodesia under the name Canadian Mariout, was released from departmental control for sowing in 1950. Like Glacier it had done well in preliminary trials but was likewise attacked by yellow rust at Ol Joro Orok and will have to be confined to areas below 7,000 ft. Again its good yielding powers and strong straw make it a useful feeding barley in such areas.

#### *Yield Trials*

Results of barley trials at Njoro, Rongai and Ol Joro Orok over the last two years are given below.

| Variety           | Njoro |      | Rongai |      | Ol Joro Orok |
|-------------------|-------|------|--------|------|--------------|
|                   | 1948  | 1949 | 1948   | 1949 | 1949         |
| Mariout .. ..     | 15.4  | 11.1 | 12.8   | 8.6  | 6.7*         |
| Kenia .. ..       | 15.2  | —    | 7.6    | 6.5  | 13.2         |
| Research .. ..    | 13.8  | 12.8 | 12.6   | 7.2  | 13.3         |
| Abyssinia .. ..   | 13.7  | —    | 10.8   | —    | —            |
| Glacier .. ..     | 13.1  | 9.3  | 10.6   | 7.9  | 4.8*         |
| Maltworthy .. ..  | 12.3  | 10.8 | 11.2   | 6.5  | —            |
| Prior .. ..       | 11.7  | 10.8 | 10.6   | 6.0  | 13.6         |
| German .. ..      | 11.1  | —    | 6.7    | —    | —            |
| Plumage Archer .. | —     | 6.5  | —      | —    | 10.5         |
| Spratt Archer ..  | —     | 9.1  | —      | 4.0  | 10.7         |
| Golden Archer ..  | —     | 8.2  | —      | 4.2  | 9.9          |
| P.05 .. ..        | 2.0   | 1.1  | 1.5    | 1.4  | 1.7          |
| P.10 .. ..        | 2.6   | 1.5  | 2.0    | 1.9  | 2.2          |

\*Glacier and Mariout damaged by yellow rust.

Yields given in bags of 180 lb. per acre.

These yield trials show the adaptability of the Australian barleys Prior, Research and Maltworthy which have all yielded well both at the low, medium and high altitude stations. Kenia is seen to be a barley for growing only at the medium and higher altitudes. In comparison with the barleys of Australian origin the English barleys Plumage Archer, Spratt Archer and Golden Archer were lower yielding.

#### *Importations*

Of the 28 barleys received from the Dominion Laboratory of Cereal Breeding, Winnipeg, Canada, in 1948, Oilli, Galore, O.A.C. 21, Colsess and Kindred were of poorer growth and may be discarded. The remainder, Hannchen, Vantage, Trebi, Compana, Titan, Montcalm, Tregal, Icelandic, Mars, Plush, Wisconsin, Sanalta, Thorpe, Newall, Velvet, Prospect, Velvon, Regal, Peatland, Chevron and Rex will be carried on for a further season. Sanalta, a two-row variety, proved outstanding with good straw and well filled ears.

The following new importations were under trial:—

*From Iraq.*—Californian Chevalier, Pryor, Chilean, Trabout, Californian Mariout and Iraqui. The first three are two-row and the remainder six-row varieties.

*From the Ministry of Agriculture, Orman, Egypt.*—Beladi 16, a six-row variety.

*From Southern Rhodesia.*—Barley wheat, Blue barley, Black barley and Trabut.

*From Potchefstroom, South Africa.*—Elses and Swanneck.

*From Cyprus.*—Beladi, Cyprus Black and Paphitico.

Owing to the dry season most of these importations grew poorly and they will be grown again during the coming year.

### Oats

Lampton, from Australia, still remains the standard variety for hay and feed with Grey Algerian as the milling variety. Lampton is suited for the 6,000-10,000 ft. but Grey Algerian becomes rather more susceptible to stem rust under 7,500 ft., and produces the plumpest milling samples over this altitude.

Achilles, an awned variety from New Zealand, has been found in further tests to possess no advantages over Lampton. It is slightly susceptible to stem rust and weaker in the straw than Lampton and its multiplication for release to farmers will not be carried on further.

The American and Canadian varieties Ajax R.L. 1114, Exeter R.L. 53, Hancock C.I. 3346, Marion C.I. 3247, Fultex C.I. 3531, Vicland C.I. 3611, Boone C.I. 3305, Cedar C.I. 3314 and R.L. Nos. 1674, 1681, 1692, 1694, 1710 and 1734 were all attacked by stem rust to a varying degree and must probably be considered too rust susceptible for general cultivation in Kenya. R.L. 1734 was least attacked with R.L. 1710 the next best in this respect.

The Southern Rhodesian varieties S.E.S. Nos. 52, 387, 389 and 416, the last three huskless, were all covered in stem rust and virtually destroyed.

*New Importations.*—Only one new importation was under test, Sunrise, from Southern Rhodesia. It stood well and was fairly free of stem rust and will be sown again for further test in 1950.

### Sunflowers

Yield trials carried out in 1948 at two centres, Njoro, 7,100 ft., and Kitale, 6,000 ft., with the semi-dwarf varieties Mars, Pole Star and Jupiter, showed that the semi-dwarfs did not yield as well as the standard variety Giant Black. This was thought probably due to the spacing which was the same for all varieties, i.e. 3 ft. between rows and 1 ft. in the row.

This season the spacing of the semi-dwarf varieties was narrowed to 1½ ft. between rows and 8 in. in the row whilst keeping the wider spacing for Giant Black. Yield trials carried out by the Agricultural Officers concerned show the following results.

| Variety     |    |    | Njoro | Rongai | Kitale | O! Joro Orok |
|-------------|----|----|-------|--------|--------|--------------|
| Mars        | .. | .. | 3.8   | 8.0    | 9.8    | 11.6         |
| Jupiter     | .. | .. | 2.7   | 8.0    | 7.6    | 8.9          |
| Pole Star   | .. | .. | 2.8   | 6.8    | 8.7    | 8.5          |
| Giant Black | .. | .. | 3.4   | 3.5    | 13.8   | 7.7          |
| P.05        | .. | .. | 0.3   | 2.0    | 1.3    | 0.6          |
| P.01        | .. | .. | 0.4   | 2.7    | 1.7    | 1.1          |

Yields given in bags of 100 lb. per acre.

At Njoro, Mars has out-yielded the remaining varieties whilst both Jupiter and Pole Star have yielded less than Giant Black. At Rongai, Mars and Jupiter have out-yielded the remainder and all semi-dwarfs have done better than Giant Black. At Kitale, Giant Black has yielded better than any of the semi-dwarfs of which Mars is the best. At O! Joro Orok, Mars has again out-yielded the



remainder and all varieties have done better than the standard Giant Black. It seems clear from these trials that the spacing of these semi-dwarf varieties must be closer both in the row and between rows, i.e. there must be a greater number of plants per acre than Giant Black, and that under these conditions the semi-dwarfs may out-yield Giant Black. The semi-dwarfs grow rather tall in the higher areas. Thus at Ol Joro Orok it is considered that Jupiter would be the best variety for mechanical harvesting as both Mars and Pole Star grew too tall. At Rongai the semi-dwarfs grew to about  $4\frac{1}{2}$  ft. high and took  $4\frac{1}{4}$  months to maturity whilst Giant Black grew to 8 ft. and took  $5\frac{1}{2}$  months to maturity.

In view of their quick maturity, good yielding abilities when closely spaced and the possibility of combine harvesting in the lower areas these semi-dwarfs are clearly worth going on with.

Other varieties imported for trial are Mennonite, Sunrise, Klein, Saturn, Advance Hybrid.

### Soya Beans

The 26 varieties tested in 1948 were again under trial at Njoro, Rongai, Eldoret and Kitale during the season. In addition, two Batavian varieties were under test for the first time. No trials were laid down at Ol Joro Orok owing to the poor growth made during 1948. It is considered that Ol Joro Orok has too cold a climate to suit Soya beans.

Varities under test included:—

*From the U.S.A.*—Mamloxi, Avoyelles, Ogden, C.N.S., Roanoke and S.100.

*From Southern Rhodesia and South Africa.*—34.S.51, 34.S.395, 35.S.277, 38.S.5, 39.S.11, 40.S.35, 41.S.31, 41.S.77, 42.S.6, 44.S.36, 45.S.2, 45.S.95, 45.S.96, 45.S.100, 45.S.101 and Hernon Nos. 18, 55, 107, 116 and 279.

*From Kongwa, Tanganyika.*—The Batavian varieties Kedele Yellow and Kedele Black.

All varieties made medium to poor growth, many lodged and all shattered to a greater or lesser extent. Two American varieties, Mamloxi and Ogden, seven Rhodesian and South African varieties, 39.S.11, 40.S.35, 41.S.77, 44.S.36, 45.S.2, Hernon 107 and Hernon 279 and the Batavian Kedele Yellow made noticeably better growth than the rest. Kedele Black showed moderate growth but failed to set seed at any centre.

All varieties will be given a further trial during the coming season.

If Soya beans are to appeal as a crop to European farmers in Kenya, varieties must be introduced or developed which make satisfactory growth and yields, are non-shattering and carry their crop high on the stem so that combine harvesting is possible. All varieties so far tested fell short more or other of these attributes.

### Maize Seed Competition

This Competition was sown at the three centres, Kitale, Njoro and Rongai last season and the average yields were respectively 14.44, 12.16 and 9.41 bags per acre. This can be considered very satisfactory in view of the poor season. Full results have appeared in the Press and will not be repeated here.

The two main reasons for the Competition are (a) that vendors be afforded an opportunity of an accurate and impartial test of the productive capacity of their seed; and (b) that purchasers be afforded some assurance of the merit of the seed which is offered for sale. The value of the Competition lies not only in the immediate advantage of the sale and purchase of proven high-yielding seed but also in the longer term benefit of showing whether seed selection is being carried out on correct lines. It is encouraging to note that farmers who

practise yearly seed selection on the lines recommended by the Department of Agriculture consistently appear in the upper half of the Competition lists. The National Bank of India Perpetual Challenge Cup is awarded annually for the best seed maize. In the two post-war competitions this cup has been won by two farmers who are known to have carried out yearly seed selection over a number of years.

Seed selection should properly be regarded as a routine farming operation. All too few farmers practise yearly seed selection in spite of the efforts of the Department to stimulate interest by the Competition and propaganda. It is considered that if every farmer made a point of practising annual selection of his seed maize then an increase in the Colony's average yield of 10 per cent or more should be easily obtainable thus adding about 80,000 bags to the European harvest alone. There is much to be done in the way of seed selection before the limit of maize improvement by this method is reached.

### Hybrid Maize Trials

With the arrival of a second plant breeder from the United Kingdom a hybrid maize programme was re-started during the season. The work is proceeding along three main lines:—

- (i) The continuation of the original work which was shut down during the war years due to staff shortages. The earlier inbred lines have been kept going by selfing and single crosses between selected inbreds were made in preparation for the double crosses to be synthesized in 1950.
- (ii) The starting of a completely new programme of inbreeding using—
  - (a) local maize varieties and strains from different parts of the Colony, and
  - (b) imported maizes from the United States, Southern Rhodesia and South Africa to obtain genetic diversity.
- (iii) The importation of inbreds and hybrids from the United States, Southern Rhodesia and South Africa for test as to suitability for growing in Kenya.

Top crosses of the 1948 S.1 lines to local Njoro maize were made during the season. These will be sown in a statistical trial during the coming year to test the combining ability and yield potentialities of these new inbred lines and so enable work to be concentrated on those likely to be most valuable. Fifty new additional plants were selected for selfing from station maize.

Dr. S. C. Harland's intra-genotypic method of maize improvement is being given a trial and was started by the selection of 100 good plants in a field of station mass-selected maize. These plants were crossed together in pairs in the first stage of the programme and the resultant seed will be tested in a statistical yield trial in 1950.

The 1950 programme will include 264 inbred lines for selfing, the production of single and double crosses from the original inbred lines and the testing of various top crosses and single hybrids in yield trials to determine those of good yielding and combining ability.

As in past seasons imported hybrids from other countries were not successful and were in most cases heavily attacked by disease, chiefly rust, *Puccinia sorghi*. The opinion is reiterated that the production of successful hybrids is essentially *ad hoc* work but maize varieties and hybrids should continue to be imported since they may contain characteristics not present in local maize which would be of use in the breeding programme.

### Sorghum

A number of dwarf and semi-dwarf sorghums were under test at Njoro, Rongai and Kitale. All grew poorly and were badly attacked by stalk borer, *Busseola fusca*, and various leaf diseases, in some cases being completely destroyed. The following is a list of importations.

*From Dr. R. E. Karper, Lubbock, Texas.*—Combine Black Kafir S.A. 5765-12 and 5765-13, Midland S.A. 5846, Plainsman S.A. 7005, Martin S.A. 5330, Caprock S.A. 7000, Early Hegari T.S. 25248, Double Dwarf White Sooner Milo S.A. 5155-5 and Double Dwarf Shallu. The first three showed the best growth followed by Plainsman and Martin, with the remaining five of poor growth.

*From Southern Rhodesia.*—W.S.W.G., Rsh, R.S., P.R.S., W.S.B.G.48, Haakdoorn sweet, Perennial, Ysh, and W.S.B.G.46. The first six grew moderately well and the final two poorly.

*From Gold Coast.*—6S, Peto and 9E. All were of poor growth.

Sorghum will grow and produce a crop under drier climatic conditions and in poorer soils than maize and is a valuable crop in such areas. If the correct varieties can be found or bred it should be possible completely to mechanize the crop in Africa, as has been done in the U.S.A., by breeding dwarf combine types. With this idea in mind a breeding programme was started during the season by the importation of material and test for suitability to Kenya climatic conditions. From this preliminary work it would appear as if imported dwarf sorghums from the U.S.A. are too susceptible to local pests and diseases to be successful in the Colony. However, it should be possible by hybridization to use the dwarf factor in these U.S.A. sorghums for lowering the height of local varieties whilst keeping up or improving yield and disease resistance. This will be the aim of the breeding programme.

### Pyrethrum

The pyrethrum breeding work is centred at the two high altitude stations, Ol Joro Orok, 7,800 ft., and Molo, 8,300 ft. During the year 17 new selections were isolated having pyrethrins contents between 2.00 per cent and 2.50 per cent and one with a content over this figure. The present numbers of high test selections now under study are:—

| <i>Pyrethrins Content</i> | <i>No. of Selections</i> |
|---------------------------|--------------------------|
| 2.00 per cent             | 145                      |
| 2.50 per cent             | 31                       |

Analyses of a bulk picking of the progeny resulting from crossing high test parents show 14 crosses with pyrethrins contents of 2.00—2.49 per cent and six crosses with contents of 2.50—2.99 per cent pyrethrins. The cross 188 × 214 has shown an average content of 2.37 per cent pyrethrins over four pickings at Subukia, 7,000 ft., and 2.45 per cent pyrethrins over seven pickings at Molo. It is proposed to issue seed of this cross and the two parents are being increased to form the necessary seed plot.

Other crosses, involving further high test parents are under trial.

### Acknowledgments

My thanks are due to Dr. R. M. Nattrass, Senior Plant Pathologist, for testing and identification of physiologic stem rust forms and for the production of material for artificial rust epidemics in the breeding cages; to Mr. W. H. Hewitt, Assistant Agricultural Officer, for help with the sowing and harvesting of the wheat plots at Scott Agricultural Laboratories; to Mr. E. W. Gaddum, Senior Agricultural Officer (Pyrethrum), for supplying the data in the section on Pyrethrum; and to Mr. P. Robinson, Statistician, Amani, Tanganyika Territory, for advice on layouts and analyses of experiments.

H. C. THORPE,  
Senior Plant Breeder.



# ANNUAL REPORT OF THE OFFICER IN CHARGE (COFFEE SERVICES), 1949

## Rainfall Records—1949

|                      | A     | B     | C     | D     | E     | F     |
|----------------------|-------|-------|-------|-------|-------|-------|
| January .. ..        | 0.14  | 0.42  | 0.25  | 0.06  | 0.00  | 0.06  |
| February .. ..       | 0.12  | 1.39  | 0.76  | 0.16  | 0.50  | 0.41  |
| March .. ..          | 0.58  | 0.68  | 0.61  | 0.13  | 0.23  | 0.04  |
| April .. ..          | 9.84  | 7.55  | 11.31 | 9.38  | 3.39  | 5.24  |
| May .. ..            | 2.08  | 1.34  | 1.73  | 2.85  | 12.55 | 8.51  |
| June .. ..           | 1.16  | 0.31  | 0.44  | 0.24  | 3.90  | 4.19  |
| July .. ..           | 0.42  | 0.22  | 0.65  | 0.17  | 7.21  | 6.71  |
| August .. ..         | 0.89  | 1.21  | 1.07  | 0.20  | 6.10  | 9.16  |
| September .. ..      | 0.28  | 0.75  | 0.56  | 0.87  | 12.41 | 9.93  |
| October .. ..        | 0.23  | 0.33  | 0.77  | 0.43  | 1.56  | 3.06  |
| November .. ..       | 1.69  | 3.13  | 2.63  | 2.30  | 0.29  | 0.86  |
| December .. ..       | 8.02  | 4.58  | 4.96  | 4.94  | 1.24  | 2.87  |
| Total .. ..          | 25.45 | 21.91 | 25.74 | 21.73 | 49.38 | 51.04 |
| Number of days .. .. | 80    | 86    | 82    | 69    | 143   | 172   |

A.—Coffee Research Station.  
 B.—Scott Laboratories, Kabete.  
 C.—Anmer Estate, Kiambu.

D.—North Kitito Estate, Makuyu.  
 E.—Kitale Experimental Station.  
 F.—Kapretwa Estate, Elgon.

## Development

The new administrative and laboratory buildings were completed, and officially opened by H.E. the Governor, Sir Philip Mitchell, on the 10th December, 1949.

A considerable amount of work was carried out on the estate coffee factory during the year, and very good facilities now exist for studies on coffee preparation, and for the handling of the estate crop. This factory has, however, a very definite emphasis on experimentation and will be modified frequently as time goes on. The stone compost layout, garage and tractor house were completed. Considerable improvements were made in the dairy buildings. A new 10,000-gallon water-tank has been built to provide water for the Soil Conservation Service Headquarters and to improve the station supply generally. Improvements to roads have been made, and the fencing programme carried a stage further. In order to give space to provide coffee seedlings for station requirements and for the planting of variety trials in many parts of the country, the coffee nurseries have been considerably extended.

At the time of writing last year's report, Government had just acquired the neighbouring Rukera Estate. At that time it was explained that this action was taken for four main reasons:—

- To increase the land available for investigational work.
- To provide land for a demonstration farm as distinct from an experimental farm. The intention is that this demonstration farm should cover a whole range of activities, e.g. dairying, fruit-growing, etc., though coffee will be the main crop.
- To provide a site for the Soil Conservation Service District Headquarters.
- To provide a site for a small sub-station to be devoted to investigational work on fruit growing and general horticulture.

In the past year considerable progress has been made with these projects. The land to be added to the experimental farm has been selected and suitably treated. Certain entomological experiments have already been commenced on it. Good progress has also been made on the demonstration farm. A farm office has been completed, and farm buildings and labour lines are in course of construction. A large proportion of the coffee on Rukera Estate was very close-planted, and a lot of cutting out has been done.

A portion of the estate has been converted to the multiple stem system. In conjunction with the S.C.S. a start has been made on the planting of four 3-acre areas of new coffee. Four different methods of terraced planting are being used, while the coffee itself will consist of rooted cuttings of four very good clones. A considerable area of Napier grass has been planted for mulch and fodder.

Mr. Brook has made good progress with the development of the S.C.S. District Headquarters. A start has been made on the terracing of the fruit sub-station.

### 1949-50 Crop Year

Although the year under review has brought record coffee prices, the year from a purely production viewpoint was a disappointing one. Drought conditions were widely prevalent and much of the crop was light and drought affected, though a few estates in Kiambu, Solai, Songhor and Nandi districts produced fine Class I coffees.

On the research station itself 25.45 inches of rain were recorded in 1949, and of this total roughly three inches comprised isolated small falls which were of no real value. Both long and short rains failed badly. There was very little early crop on either estate, but this was of better quality than the late crop, probably as a result of the good short rains of the previous year. Production figures for both estates were as follows:—

|           |    |    |       | <i>Clean Coffee</i><br>tons | <i>Mbuni</i><br>lb. |
|-----------|----|----|-------|-----------------------------|---------------------|
| Jacaranda | .. | .. | ..    | 8.9                         | 9,434               |
| Rukera    | .. | .. | ..    | 9.1                         | 55,764              |
|           |    |    | Total | 18.0                        | 65,198              |

It is the intention to publish annually in the Coffee Board Bulletin a balance sheet for the demonstration farm (Rukera) as soon as final crop payments are known.

### Field Trials at the Coffee Research Station and Sub-stations

*Coffee Research Station.*—Investigations continued on the following trials: cultivation experiment; manurial trial; two-shade tree trials; copper spray trials I and II; pruning trial; variety trial; nutrient spray trial; and crop picking trial. During the year a new mulching trial was laid down.

*Kitale Experimental Station.*—Recording of the mulching and manurial trials was continued. These two trials are due to be considerably modified in 1950. A summary of results to date was published in the Coffee Board Bulletin for September, 1949, and the pruning and size of planting holes experiments have been concluded. A revised programme for the work at this station has been approved, and measures to initiate new trials are proceeding.

*Kapretwa Estate, Elgon.*—The pruning trial on this estate has been discontinued, the results obtained having been published in the Coffee Board Bulletin for September, 1949. Individual recording of trees of "Thorold's" coffee has been carried out.

*Anmer Estate, Kiambu.*—The two variety trials were continued.

*North Kitito Estate, Makuyu.*—The variety trials were maintained on the station throughout the year. Individual recording of the leaf-disease resistant selection K.7 was carried out.

These various trials are reported on more fully in the reports of the Agricultural Officer and Specialist Officers concerned.

### Investigational Work on Coffee Preparation

Apart from routine quality studies on experimental samples and investigations referred to under the section on Plant Pathology/Physiology, investigational work on coffee preparation included an experiment of factorial design to compare pre-washing against no pre-washing; dry fermentation against underwater fermentation; and washing during fermentation, nil, once, twice, and three times daily. Full results of this experiment are not yet available, but more details of it are given in the Agricultural Officer's report.

A considerable amount of practical work was also done under the general heading of "Measures to reduce water pollution in coffee factories". This work, to which considerable importance is attached, will be written up in due course.

Some tests were carried out with an innocuous protective paint for treating plaster in coffee tanks, and there appears to be every chance that something of practical value will accrue from this work.

### Entomological Work

Mr. D. J. McCrae's arrival in September came as very welcome news to planters. Up to this time Mr. Melville had had to find what little time he could for entomological matters both investigational and advisory, and, with the whole development plan coming to a climax in time for the opening ceremony in December, this branch was inevitably somewhat neglected. With the great improvement in the staff position, the entomological investigational programme is now making progress.

The routine breeding of mealybug parasites is in course of being transferred from the Scott Laboratories to Ruiru. During the past year, mealybug has caused some concern in parts of the Thika District and Upper Kiambu, though generally speaking, biological control has been very adequately maintained.

*Leafminer (Leucoptera coffeella)* caused serious defoliation in many parts of the East Rift area. An examination of a large number of outbreaks indicated that the cause was most probably some seasonal interference with natural enemies, and that it was definitely not associated with the application of any insecticide. Observation also tended to support the idea that leafminer was more evident on trees suffering from severe crop or other strain.

*Antestia* has caused serious damage in many districts. In some measure this state of affairs is due to failure to carry out accurate routine testing—a measure recommended by the Department for many years.

If large populations are allowed to build up, the difficulties of control are correspondingly increased. A further difficulty has been the great increase in the price of pyrethrum powder. On the other hand, the quality of the pyrethrum has been very much better than that supplied in recent years.

The long-term experiment on the use of BHC (in the form of "Agroicide" Wettable Powder) has been continued, and planters have been recommended to use this insecticide in blocks where a high population of *Antestia* exists, but not to use it simultaneously throughout an estate in the meantime. Pyrethrum should still be used for less badly infested blocks.

Mr. McCrae's main line of work is the study of the more persistent insecticides in coffee. It will be recalled that considerable value is attached to biological



control in the main Kenya coffee areas, more especially in those where the Common Coffee Mealybug exists.

Although little evidence has so far been accumulated, it appears that BHC is much less persistent in coffee than DDT, though the reactions of specific natural enemies have not yet been tested.

A long-term experiment on the use of DDT in coffee has also been laid down in a block of coffee in the part of Rukera Estate that will be added to Jacaranda.

*Thrips* has caused serious damage on a number of estates and has, in general, in the Kiambu, Ruiru and Thika areas required very serious attention. The standard method of control is still the Paris Green/Molasses spray but, owing to a failure in supplies of Paris Green, DDT had to be recommended. Experiments at the station have shown very good control of thrips with 0.1 per cent DDT sprays, but these were only recommended as an emergency measure this season because of the lack of Paris Green.

The residual effect achieved with DDT at this strength appears to be about three weeks.

Observations have continued on the berry-borer pest in the Trans Nzoia.

The first post-war White Borer campaign has been conducted in the Mitubiri, Maragua, Makuyu, and Donyo Sabuk districts from 1st January to 31st March, 1950. The campaign has been very successful, and will be followed by a further campaign from the 1st June until 15th October, 1950. The control method used was that recommended by Robertson (*E.A. Ag. J.*, July, 1949) using Ethylene Dichloride Carbon Tetrachloride mixture (75 per cent/25 per cent) diluted in an equal volume of lead-free petrol. Testing of proprietary insecticides, including banding greases, and equipment, has occupied a considerable amount of time.

### **Native Coffee Growing**

Considerable progress has been made in coffee growing by Africans during the year. Instructors from various districts have attended the Coffee Research Station for training. Plans are in hand for the planting of variety trials in many areas, and in new areas where there is sufficient local knowledge already available pilot planting schemes are being commenced.

### **Vegetative Propagation**

Work on the vegetative propagation of coffee has continued satisfactorily. In the course of the year more rooted cuttings have been planted out in the area set aside for blocks of clones near the propagation frames. Four of the best clones have been selected for new commercial blocks to be planted on the demonstration farm, namely SL.9, SL.14, SL.28, and SL.34.

Each of these selections will be planted on a different system of terraced planting. A start has been made with the planting of these cuttings in the long rains of 1950.

### **Pasture Improvement, Growing of Mulches and Fodder Cropping**

The programme of pasture improvement previously outlined has been continued, though admittedly with great difficulty as a result of lack of rain. In spite of the severe conditions, however, the Nzoia strain of Rhodes grass has performed remarkably well.

Hunter River lucerne sown in mixture with Rhodes grass in paddock No. 5 in 1948 is still growing strongly, and this legume appears to be well worth inclusion. The past dry year has re-emphasized the value of Napier grass as a fodder. A manurial experiment on silage maize carried out by Mr. Jones has shown promise of improving this crop in the break-up period of the ley system.

A series of grass and legume plots has been laid out and planted with the primary object of enabling observations to be carried out on species of potential value as pasture or ley constituents, mulches, fodder, and cover crops. These plots will be treated with artificial manures in strips (sulphate of ammonia and double superphosphate both alone and in combination).

On the question of mulch species, Napier grass is undoubtedly the best proposition in this area at the moment. Some potentially promising mulch species have been planted in the plots, most of which, if they measure up in other ways, will have the advantage of being capable of mechanical cutting. A simple strip experiment to test the value of treating Napier grass with artificial manures has been laid out on Rukera Estate on a new block of grass planted in the short rains of 1949.

### **Cattle**

A clear cattle policy has now been decided for the two farms. On Jacaranda, the existing herd of Boran cattle will be maintained with the object of selection for general hardiness and milk production. Only good Boran bulls of milk type will be used in future, and the small Sahiwal element in the herd will be gradually submerged.

On the demonstration farm, the foundation stock will be half-bred Guernsey/Boran heifers which will be inseminated with pure-bred Guernsey sperm. In the course of time, comparative data will accrue on the performance of the Zebu animal, and various dilutions of Zebu with an exotic breed.

### **Advisory and Extension Services**

The great improvement in the staff position has made it possible to extend considerably this side of our activities. Since the opening of the laboratories in December, 1949, there has been a steady and gratifying flow of visitors to the station, and the volume of advisory correspondence has also increased considerably.

As in the past, the station has been the venue for trials and demonstrations of agricultural machinery, and various other gatherings of interest and value. One of the best of these was the opportunity afforded to a group of planters and members of the Coffee Services of having a discussion with Mr. Devonshire at the factory in the middle of the picking season.

The Station staff has made numerous contributions to the Monthly Bulletin during the year, and the Officer-in-Charge has contributed the regular feature entitled "Coffee Research Station Notes", and served on the Editorial Sub-Committee.

### **Coffee Research Committee**

The following planters have served on the Committee:—Mr. G. B. Shields, Mr. R. V. Lane, Major P. G. McMaster, Mr. A. F. Beakbane, Mr. N. R. Solly, Mr. B. M. Aagard, Mr. J. F. Perkins.

The Officer-in-Charge, Coffee Research Station, Mr. A. R. Melville, has acted as Chairman of the Committee during the year, and Mr. I. G. H. Maclean, Executive Officer of the Coffee Board, has attended meetings. Members of the Coffee Services have attended meetings by invitation. The minutes of all meetings have been published in full in the Monthly Bulletin of the Coffee Board. Perusal of these minutes will show the wide range of subjects of great importance to the industry discussed during the year, and the value of this Committee is becoming increasingly apparent.

### Publications

The following articles and notes have been contributed to the Monthly Bulletin of the Coffee Board of Kenya during the period under review:—

January.—“Some Experiments with *Antestia*” by A. R. Melville.

April.—“Propagation of Coffee from Cuttings” by E. Cottington.

July.—“Routine Testing to Determine the Population of *Antestia* and *Lygus* in Coffee” by A. R. Melville.

September.—“Field Trials with Coffee in the Trans Nzoia” by P. A. Jones.

December.—“Observations on the Life-History and Control of White Borer of Coffee in Kenya” by C. D. Knight. (Reprinted from *East African Agricultural Journal* for July, 1939.)

### Other Publications:—

“The Use of Pyrethrum on Kenya Coffee Estates” by A. R. Melville. *Pyrethrum Post*. Vol. 1, No. 4. April, 1949.

### Acknowledgments

As in the past, Mr. Devonshire and the staff of the Liquoring Department have given us a great deal of assistance in connexion with the evaluation of experimental samples, and this help is gratefully acknowledged.

Finally the Officer-in-Charge, Coffee Services, would like to thank all his staff for their hard work and co-operation during the year.

A. R. MELVILLE,  
Senior Entomologist (Coffee).

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## ANNUAL REPORT OF THE AGRICULTURAL OFFICER (COFFEE SERVICES) FOR 1949

Investigations undertaken during the year are described briefly. At the time of writing it is not possible to give conclusions from results obtained as, owing to my departure on overseas leave, the year's results have not been analysed and work on quality factors is incomplete.

### Field Trials—Coffee Research Station

*Copper Spray Trial I.*—The layout and design of this trial were described in the 1947 Annual Report. Cherry yields and die-back counts were recorded for the third year. The copper sprays were applied on the 25th of May. Since the principal object of the trial is the study of leaf-fall and its prevention, the leaf scores made in previous years were replaced by leaf counts: from the 13th of June until the 12th of December, leaves which fell from trees on all plots were counted at fortnightly intervals. Thus a complete picture was obtained of the effect of treatments on leaf-fall throughout the season. In addition during the picking season 105 quality samples were taken.

*Copper Spray Trial II.*—Described originally in last year's Annual Report, the trial was continued in the second year; early, mid-season and late sprays (burgundy 2 per cent at 4-3 pints per tree) were applied on May the 13th, June the 1st and July the 11th respectively. From the 6th of June, leaves which fell were counted as described above. Cherry yields and die-back were recorded and 42 quality samples were taken.

*Trial with Proprietary Copper Sprays.*—A small trial was laid down using "Blitox" and "Perenox" at a concentration of 2 per cent. Subsequent leaf-fall counts showed that the two sprays had been equally effective in preventing leaf-fall.

*Pruning Trial.*—The trial was first described in the Annual Report of the Officer in Charge (Coffee Services) for 1946. Cherry yields and die-back were again recorded and 64 quality samples were taken to compare the four treatments.

*Crop Picking Trial.*—The coffee picking season may extend over four to six months of the year, a fact which often prohibits the greater use of replicated trials on sub-stations where supervision is generally not available at this time of year. The desirability of reducing crop recording to a single harvest is obvious. The aim of this trial, therefore, was to investigate the accuracy which could be obtained when the number of pickings was reduced from the normal to one or two for the season. With eight replications, normal picking was compared with end-of-season picking with or without a mid-season picking. There is every indication that one harvest at the end of the picking season gives as accurate an assessment of the yield of clean coffee as does normal picking.

*Shade Tree Trial.*—Recording commenced on this trial during the year and cherry yields of 240 individual trees were measured for both early and main crops. As the effects of the shade trees on the adjacent coffee increase, it will be possible to compare the reaction of the coffee (on both single and multiple systems) to the six species of shade trees in the trial.

*"Fernoxone" Trial.*—By means of this small trial, some preliminary information has been obtained regarding the effects of 2. 4. D sprays on coffee. Single lines of mature single-stem trees were sprayed with "Fernoxone" at the rate of one gallon per tree, and at three concentrations, viz. 8, 16 and 32 parts per million. The effects compared with unsprayed trees were recorded by five sets of samples from 30 pairs of trees.

*Fermentation Trial.*—A trial on quality factors during 1948 was reported by the Agricultural Chemist in his annual report for that year. In order that these

findings might be confirmed a comprehensive trial was carried out with bulk samples on an estate scale. A  $2^4$  factorial design permitted the investigation of the following preparation treatments in combination:—

Pre-washing and Control.

Dry fermentation and under-water fermentation.

Effect of washing during fermentation; no washing, washing once, twice and three times daily.

The resulting 16 treatments were confounded into two blocks of eight. A uniform bulk of cherry was pulped on December the 7th, and treated for the first block in the following four days. The second block was pulped and treated on December 30th and the four following days. A set of 16 complete sub-samples was taken from each block and fermented according to treatment in four-gallon aluminium bowls. Partial analysis of the liquoring report on the resulting 48 samples indicates that there were no consistent responses to main treatments, a surprising and disappointing outcome in view of past experience with factory preparation.

*Other Trials on the Coffee Research Station.*—In co-operation with the Agricultural Chemist, the cultivation, manurial and nutrient spray trials were continued. In addition, a factorial trial was laid down in June to test the effects of four levels of napier grass mulch, compost and nitrogenous fertilizers. The results from these four trials are contained in the annual report by the Agricultural Chemist.

### Pasture Improvement and Fodder Cropping

The programme for pasture improvement was outlined in the annual report for 1948 by the Officer in Charge, Coffee Services. In the light of experience gained in the operation of this programme, a number of major problems requiring field research are expected to arise. The foremost of these has been the production of silage crops in the arable courses of the ley rotation. Hitherto, observations on the Station and elsewhere suggest that Yellow Durum maize is most suited for the purpose, although the volume of green leaf and stalk produced has been generally poor. In previous seasons, the effect of manures, such as compost, ammonium sulphate and locally produced phosphates have been applied in strips across fields sown to maize for silage, but without apparent beneficial effect.

*Maize Silage Trial.*—On 21st October, a trial of orthodox design was planted to investigate the problem of manuring silage maize. A single replicate of the  $3 \times 3 \times 3$  factorial design was employed to include the following treatments in combination:—

Nitrogen.—Ammonium sulphate: nil, 110 lb. and 220 lb. per acre.

Phosphate.—Triple superphosphate: nil, 110 lb. and 220 lb. per acre placed below the seed.

Spacing.—Rows 2 ft. apart; intervals between plants in the row: 6 in., 12 in. and 18 in.

Effective rain did not fall until the second week in December and a very short growing season ensued. Nevertheless, the response to phosphate was outstanding; plots to which phosphate had been applied yielded maize which was both taller and heavier than the control. As was to be expected in such a season, plant competition due to closer spacing was not sufficient to reduce height and weight of plants. Despite the heavy dressing of phosphate, the germination appeared unaffected on those plots receiving the highest application. This trial will be repeated.

### Field Trials on Sub-stations in the East of Rift Districts

*Anmer Estate, Kiambu.*—The two variety trials were again recorded: cherry and clean coffee yields of individual trees were obtained. At present the results of quality sampling are incomplete.

*North Kiitito Estate, Makuyu.*—During the severe outbreak of leaf-disease at this sub-station in 1947, the leaf-disease resistant selection on K7 showed complete immunity. Records respecting this selection show that the quality of bean produced is often inferior. During the year under review, clean coffee from 12 trees was examined by the Coffee Board's Liquorer and selection of trees yielding coffee of good quality will be attempted. Further recording, propagation and reselection of K7 are proposed.

### Field Trials in the West of the Rift Area

*Kitale Station.*—Results of recording on the Mulch and Manurial Trials are not yet available. It is intended that both these trials shall be modified during 1950. A revised programme for the remaining trials at the station has been approved and measures to initiate new trials are proceeding.

*Kapretwa Estate, Mount Elgon.*—The Pruning Trial on this estate was discontinued. Through the kind co-operation of the owner of the estate, individual trees which have been given the general designation of "Thorold's Series A" were recorded for clean coffee yields; additional evidence regarding the parent trees of this series will be required for extension of the programme of variety trials in Nyanza and at Kitale.

### Variety Trials

*Native Reserves.*—Proposals for planting and operation of variety trials in native areas were circulated to districts during February and subsequently approved. Arrangements are now nearing completion for planting of trials during 1950 and 1951 in four districts in Central Province, in South and North Nyanza and in the Teita Hills.

*Coffee Research Station.*—Two variety trials were proposed and designed in which 36 of the best selections and varieties will be tested. The first trial will be planted in April 1950 and the second in the following year.

*Solai.*—Four trials were designed and arrangements were made for planting at Rhodora and Milmet Estates in Solai. The first pair of these will be planted in April 1950 and the second pair in 1951.

### General

It is satisfactory to record that the scope of field trials on the Coffee Research Station was considerably expanded during the year. For the first time, quality samples from every main crop picking were obtained. The rate of extension of field work is adequately illustrated by the following figures:—

| Year                                           | 1947  | 1948  | 1949  |
|------------------------------------------------|-------|-------|-------|
| Total number of trial plots ..                 | 361   | 402   | 728   |
| Number of plots picked during the season .. .. | 2,049 | 2,838 | 4,909 |
| Number of quality samples ..                   | 66    | 147   | 1,112 |

P. A. JONES,  
Agricultural Officer.



# ANNUAL REPORT OF THE PLANT PATHOLOGIST AND PHYSIOLOGIST, COFFEE SERVICES, FOR 1949

## General

The main experimental work carried out was concerned with the so-called "tonic" copper-spraying of coffee and was directed towards determining the method of action of these sprays. An *ad hoc* investigation of the causes of an onion-like tainting of coffee liquor was made later in the year and some preliminary work on methods of determining transpiration was also carried out. Growth, climate and soil moisture records continued to be taken on the block of coffee trees at the Scott Laboratories.

In order to prepare some of the work on the Upper Kiambu characteristic flavour for publication, a mathematical study of the greenness factor was made.

Together with other members of the Coffee Services, I visited the Solai district in September and it was decided to set up certain preliminary experiments in order to determine the probable best date for applying copper sprays in this district.

## Leaf-fall and Copper Sprays

### *The Effects of Non-Copper Fungicides*

The experiment on the effects of non-copper-containing fungicides on leaf-fall and yield was continued for a second year. The sprays were applied on the 29th of April and the 17th of June. Instead of a copper injection treatment, one gallon of a copper sulphate solution containing the same amount of copper as sprayed on the trees in the copper spray treatments, was watered on to the ground under the canopy of the trees.

As in the previous year, there were two leaf-fall periods, the first being from the third week in August to the third week of November, and the second from the second week in January to the end of March. The total amount of leaf shed was considerably less than in the previous year. All the sprays reduced leaf-fall considerably, the relative effects, taking the control as 100 per cent, being as follows:—

|                                          |    |    |    |                |
|------------------------------------------|----|----|----|----------------|
| Lime Sulphur                             | .. | .. | .. | 60.2 per cent  |
| Tulisan                                  | .. | .. | .. | 64.6 per cent  |
| Magadi Ash Burgundy                      | .. | .. |    | 65.8 per cent  |
| Carbide Bordeaux                         | .. | .. | .. | 81.3 per cent  |
| Copper Sulphate watered on the<br>ground | .. | .. | .. | 100.1 per cent |

The results confirm those obtained last year, though Carbide Bordeaux appears to have been less effective. From the graphs of the march of leaf-fall, it would appear that the sprays were effective in reducing leaf shedding throughout the first shedding period and until the beginning of March during the second period. This means that the second spraying was presumably effective in reducing leaf-fall for some nine months after its application. The time which elapsed from spraying until it first became effective this year was obscured by the late onset of shedding, but last year it appeared to be about two months. As the average length of life of a sprayed leaf is believed to be in the region of twelve months, it would appear that spraying a leaf younger than about four months and older than about two months before it would be shed normally (at 9-10 months without spraying), is not likely to be effective in increasing its life, but is effective anywhere within these limits. Further, more detailed observations are indicated to confirm this extraordinarily long period of efficacy.

Yield figures for the different treatments were once more rather disappointing, but the crop was very small and perhaps therefore, not likely to reflect any effect of increased leaf population and reduced replacement of shed leaves. Whereas Carbide Bordeaux out-yielded the control in cherry weight, it was slightly lower in clean coffee, as were all the other treatments. The yields were as follows:—

|              | Cherry Weight 1949 |          | Cherry Weight<br>1948 plus 1949 |          | Clean Coffee 1949 |          |
|--------------|--------------------|----------|---------------------------------|----------|-------------------|----------|
|              | lb./12<br>trees    | per cent | lb./12<br>trees                 | per cent | cwt./acre         | per cent |
| Control ..   | 47.85              | 100.0    | 119.59                          | 100.0    | 1.97              | 100.0    |
| Manurial     |                    |          |                                 |          |                   |          |
| Copper ..    | 44.65              | 93.2     | 116.99                          | 97.8     | 1.85              | 93.9     |
| Carbide      |                    |          |                                 |          |                   |          |
| Bordeaux..   | 68.90              | 143.9    | 120.47                          | 100.8    | 1.89              | 95.9     |
| Burgundy ..  | 45.33              | 94.6     | 169.00                          | 141.3    | 1.74              | 87.9     |
| Tulisan ..   | 39.34              | 82.2     | 125.76                          | 105.2    | 1.61              | 81.5     |
| Lime Sulphur | 41.31              | 86.4     | 115.51                          | 96.6     | 1.54              | 77.9     |

Over the two years, the yields have shown little effect of spraying, perhaps since the trees are yet to bear a normal sized crop.

In September the trees were scored for depth of greenness, density of vegetation and amount of "weak" spotting. Leaf spotting after correction for number of leaves on the trees, was least with the copper sprays, intermediate with the non-copper sprays and most with watered on copper and the control. Leaf density was highest with the Bordeaux and Burgundy-sprayed trees, least with the Tulisan-sprayed and controlled trees. The depth of greenness observations indicated that the treatment with copper sulphate watered on to the ground had apparently induced a development of dark-green coloration approaching that given by the Bordeaux copper spray, the lime sulphur and Tulisan-sprayed trees were intermediate and the Burgundy and control trees had the lightest green coloration. This finding and the lack of crop response to sprays so far has underlined the necessity for continuing the experiment for at least two more years in order to determine whether the effect of copper-spraying on yield may be due to some further effect than the apparently fungicidal one which promotes longer leaf life.

#### *Structure of "Weak" Spots*

The structure of "weak" spots was investigated some years ago (*vide* Annual Reports for 1941 and 1942) using the rapid freezing microtome method for cutting sections. The point at issue then was whether recognizable mycelium of *Hemileia vastatrix* could be seen in the spots. The conclusions were in confirmation of the earlier findings of McDonald, that no such mycelium could be detected. Although the spots definitely suggested fungal invasion, except for a few hyphae in some superficial dead tissue in the crater of one spot, no organism could be seen invading the leaf.

The discovery that leaf-fall may be controlled by fungicides, whether containing copper or not, has refocused attention on minor fungal attacks on the leaf tissue and in particular on the "weak" spots, so that a more careful examination of their structure was considered necessary.

In the first place, freezing microtome sections of fresh tissue were taken and the spots were also examined under the dissecting microscope. It was found that the crater-like structure previously reported was a comparative rarity. More commonly a simple swelling occurs on the lower surface of the leaf, sometimes

accompanied by a slight protuberance of the upper. The underlying mesophyll consists of polygonal cells closely packed together without air spaces, but separating into a mealy mass when the epidermis is removed. The palisade tissue is thin over the region of the spot and this no doubt accounts for the yellow appearance, together with the translucence due to the absence of air spaces in the mesophyll. Away from the spot the mesophyll has extremely large air spaces and is thus a very spongy open network of tissue. The distribution of the stomata over the spot did not show them to have any special spatial relation to it, even where the latter was small; however, even with such a spot, the number of stomata lying above it is quite considerable and more than one stoma is in the central region. No fungal mycelium was detected in any of the freezing microtome sections, nor in squashed preparations of mesophyll plus epidermis from the spot. However, the mealiness of the tissue caused many and possibly all sections through the central region of the spots to disintegrate. Serial sections were therefore prepared from paraffin embedded material and stained by either Margolena differential or the Ikata stain schedules. With both of these, fungal mycelium was clearly shown to be present in the central region of the spot, penetrating as deep as the palisade tissue. The disintegration of the mealy tissues no doubt explains the failure to detect fungal mycelium in the spots when using the freezing microtome method.

Usually only one strand or group of strands of mycelium passed more or less vertically through the mesophyll of the leaf and did not ramify in the surrounding tissue to any extent. The staining of the surrounding tissues indicated pectinization of the cell walls. As far as could be ascertained penetration of the epidermis was direct and not via a stoma. The whole picture is one of a strong resistant reaction on the part of the host which completely localizes the fungal attack. The fungal origin of the "weak" spots is thus no longer in doubt.

In the previous investigation, an attempt was made to isolate a fungus from the spots by excising small pieces of tissue containing a spot from the leaf. *Colletotrichum coffeanum*, *Phoma* sp., etc., were obtained from every piece of tissue whether or not they included "weak" spots. As it is now known that the fungus penetrates deep into the leaf tissues, and as the fungi obtained before have been shown to cause very superficial infections in other plants (Simmonds, J. H. Roy, Soc., Queensland Proc., 52 99, 1941) an attempt at isolation from these deeper tissues was made. The leaf surface was sterilized with spirit and the epidermis overlying a spot removed under sterile conditions. A portion of the underlying mesophyll was excised and placed on an agar slope. Except for the odd obvious contaminant, no fungal hyphae grew out. The superficiality of the *Colletotrichum* and *Phoma* infections is thus confirmed, and it must be assumed that the fungus causing the yellow spots was either dead or of a fungus which will not grow on an artificial medium. Further work with very young spots is indicated.

#### *Length of Leaf life and age at which "weak" spots appear*

Information as to the length of leaf life without spraying has so far been indirectly obtained only. Some of the branches used for growth records afforded an opportunity to get direct evidence on this point, as the age of each leaf on these branches was known. At the same time information as to the age at which weak spots first make their appearance, when they become severe, when bark ripening occurs and when young leaves take on a mature appearance, was obtained.

Twenty-four branches scattered at random over three trees were used. They were recorded at fortnightly intervals for presence or absence of leaves on each node, state of the leaves as regards "weak" spotting, whether the leaves were of immature appearance and to what point bark maturation had occurred. "Weak" spotting was observed by holding the leaf up with the lower surface towards the observer and the upper towards the sun. On dull days, an electric lamp was used. The results of these various observations are given below.



### *Leaf Shedding*

From August to the beginning of November, there was a marked period of shedding of leaves which had been formed in the major part of the short rains growth of November to January. From February to March a second shedding period was observed, the leaves falling at this time being those which had been formed in the previous long rains. A second minimum shedding period occurred during the long rains. There are thus two periods of maximum shedding and two periods of minimum shedding in the year corresponding to the two minimum and two maximum growth periods respectively, the leaves shed in the two maximum shedding periods having been formed in the previous two growth periods.

During the first shedding period (August to November, 1949) the average age of leaves when shed remained fairly constant, being around about 32 weeks. On the whole, slight troughs in the shedding curve were reflected by slight increases in average age of shed leaves. During the minimum shedding period in December to January, the average age at shedding changed little until towards the end of the period, when it increased to a very considerable extent and during the January to March shedding period, reached an average level of 42 weeks.

The correspondence of shedding periods with previous growth periods raises the question as to how much the shedding periods are a mere reflection of these and due to there being at these times a preponderance of leaves of sufficient age to be shed. In order to see to what extent this might be true, a frequency distribution curve of shedding ages was calculated from the June to December data for 1949, adjusting the figures from each fortnightly observation for their mean. The distribution of ages of leaves on the branches at fortnightly intervals, grouping the data in two-week intervals, was then calculated.

Assuming that at maximum shedding, if there were no shift in average age of shedding, the maximum age of leaf would be 100 per cent shed during the following fortnight and the other ages would be proportionately shed according to the corresponding frequencies deduced from the frequency distribution curve of ages of leaf when shed, and adjusting each fortnight's data for the average age of leaf shed in the following fortnight, the number of leaves which should have been shed at the maximum was calculated. This was found always to exceed the numbers actually shed, although at times only by a fairly narrow margin. During the minimum shedding period of November to January, the difference was considerable and reached its highest level. It must therefore be concluded that the supply of leaves of sufficient age to be shed was never limiting and certainly is not the reason for the periods of minimum shedding, which must therefore be attributed entirely to a lengthening of leaf life. It is to be assumed that during these periods abscission occurs less readily, and since they occur when growth is maximal, by analogy with other plants, they are probably periods of maximum auxin production and the greater concentration of this at the leaf bases would naturally reduce abscission. The minor fluctuations in the shedding curve are all reflected by variations in the average length of leaf life. Naturally, the supply of leaves for a period of shedding is dependent on the previous growth period and should this be a poor one, as the margin at times between leaves of an age to be shed and those actually shed is quite small, it is conceivable that in other seasons, the amount of leaf produced in the previous growth period might easily limit the amount of shedding in a maximum shedding period. The important point is however, that the minimum shedding period is not controlled by supply of leaf of sufficient age.

That the leaves shed in the June to September period of maximum shedding are younger than those shed in the February to March period would appear to be a consequence of the timing of the growing and resting periods. Thus, the long rains growth period usually centres around April to May. Leaves formed then are too young to fall before the short rains growth period, which centres

around November, but is often later, and they do not reach the February—March shedding period until they are on the average 9—10 months old. On the other hand, with the short rains growth, which if early is in October, the first formed leaves are only seven months old by the beginning of the minimum growth period in June. If the short rains growth is late and in January, the leaves are seven months old by the end of August and the minimum growth period has still another month to run. The importance of prolonging the life of these leaves by spraying at the end of the long rains is thus emphasized, since without this aid, they are the shortest-lived leaves produced by the tree.

#### *Yellow or "Weak" Spotting*

Up to the end of the year, two degrees of infection were distinguished, "mild" in which there were one or more small spots, and "severe" in which spotting was abundant and the spots were fused forming marked translucent areas. The latter type of infection was relatively uncommon.

The ages of leaves when the first signs of yellow spotting were observed and the average age was found to be in the region of 21 weeks. The age at which severe spotting was first observed averaged 29.8 weeks, the fortnightly averages varying from 24.4 to 34.4. In the case of mild spotting, the fortnightly averages varied from 18 to 26.6. They were low in June to August, climbed to a peak between mid-November and the end of December and then fell in January. The fortnightly averages for severe spotting showed a peak in early August and a second and higher peak at the end of December. They would appear to follow a similar course to those for mild spotting, but about ten weeks later. The possible causes for these variations have not, as yet, been investigated. The numbers of leaves showing symptoms for the first time fluctuated considerably. There were peak periods in July-August, October-November and January-February. It would appear possible that these may be related to the rainy periods which occurred two to three months previously when fungal infection would be likely to occur. If this is so, infection would occur when a leaf was about 10 weeks old, become visible at 21 weeks, fully developed at about 30 weeks, the leaf being normally shed soon after.

#### *Maturation of Bark*

There are two stages in maturation. In the first, a dark rich chestnut brown colour is taken on; in the second there is a change to a light greyish sienna, which is often thickly dotted with minute fungal fructifications. The average age of the youngest node in the first stage, when the twigs were first observed at the end of June was 42.4 weeks and it fell gradually to 35.1 in September to rise again to 44.7 at the end of December. If there had been no extension of the brown areas into younger internodes, the average increase in age from fortnight to fortnight would have been two weeks. The difference of the increase of the average ages observed at fortnightly intervals from two, therefore, gives an indication of the rate at which fresh tissue was being affected. Using this method, the maximum rate was observed to occur in August and during December it fell to zero to increase again in January-February. It would appear that bark browning is an activity which occurs at the end of each growth period. It was not possible to obtain such precise data on the second stage of maturation owing to the internodes not having been under observation for a long enough period. However, August and September seem to have been months of little activity, whereas maturation of fresh tissues occurred most abundantly in December, these being the same tissues which had ripened to the brown colour in August. There was some indication that there had been a maturation period previous to the beginning of the experiment. Thus the second stage of maturation appears to occur at the end of the rains. Towards the end of the period under review, it was possible to obtain an estimate of the age at which this second phase of maturation occurs, an average figure of 53.7 weeks being obtained.

### *Age at which Leaf Matures*

When the leaves are first produced, they have a glossy light green, sometimes bronzy appearance. The loss of this glossy appearance occurs relatively rapidly, so allowing an estimate to be made of the average age of the leaf when this occurs. It is of some importance in certain experimental work to know this age, and it is also of general interest to know how much reliance can be put on the presence of glossy juvenile leaves as an indication of whether active growth is occurring.

The average age over the period under review at which maturation occurred was 12.2 weeks and it ranged in individual cases from 5 to 23 weeks. Maturation was most rapid immediately after the long rains and became longer as November was approached, when all leaves formed in the long rains had matured. The short rains flush started maturing at about 11.8 weeks old on the average, with a range of 9 to 16 weeks. The increase in the time taken for leaves to mature explains the false impression of active growth from the juvenile appearance of the leaves, which one may get at certain times of the year, when actually little growth is occurring.

### *Spraying and Leaf Life*

An experiment was commenced in October to obtain data on the effect of spraying at a number of dates throughout the year on leaves of various ages. Once more advantage was taken of the growth-recorded branches to provide material of known age without having to commence with a year's observations of date of leaf formation on the experimental branches before starting the experiment. Eighty-four branches were used on nine trees, three of which were irrigated and had 35 branches. These 84 branches were divided into 12 series of seven each, each tree having one series and sometimes two. One branch in each series was sprayed, and it is planned to spray a further branch in each series when two more months have elapsed and so on until six branches will have been sprayed, one branch thus remaining as a control. Fortnightly observations of leaf-fall are being taken and records made of the age of the leaf when it fell, at what age and when it was sprayed. It is too early to carry out any analyses of results so far.

### **Onion Taint**

Early in the 1949/50 picking season, Mr. Devonshire drew attention to the recurrence of a peculiar onion-like taint of certain coffee liquors, which had caused some trouble also in the previous season. In consequence I visited a factory in Ruiru which had been producing onion-tainted coffee. There was no obvious source of tainting and I therefore set up a number of experiments in collaboration with the manager, Mr. Johanssen, of Twiga, Ltd., to see whether the source of the taint could be discovered.

The details of the investigation pursued have been published in the Bulletin of the Coffee Board of Kenya for May, 1950, p. 324, so that only a short summary need be given here.

From samples of parchment coffee taken at the factory, it was ascertained that the taint must have been in the coffee previous to its removal from the drying trays. A number of factors had been suggested as possibly responsible for the taint. These included too long a contact with water (i.e. by frequent washing during fermentation), *Antestia* damage, over-ripe coffee and polluted water. A 2<sup>4</sup> factorial experiment with sixteen treatment combinations was set up to test some of these factors. Half the coffee was fermented at the estate with Theta river water and half at the Scott Laboratories with Nairobi municipal water. Half of each of these lots consisted of cherry picked out for complete over-ripeness and half again of each of these was washed three times each day during fermentation, the other halves only receiving one washing during the



entire fermentation period. Finally, half of each of these came from Kaini Estate and half from Mugutha Estate, these being the two estates whose coffee was normally fermented together in the one factory.

Unfortunately, none of this coffee produced onion taint, but the effects on quality were worth noting. The effects of each treatment were small, but they were largely additive, a maximum difference of just over four commercial classes being found between two sets of treatments. The highest difference for a treatment by itself was, however, only just over half a class.

Frequent washing produced an overall improvement of just over one-third of a class; there was no effect with over-ripe cherry however. On the factory scale, little effect of frequent washing could be detected.

The over-ripe coffee was only half a class worse than the normal coffee, which considering it represented a degree of over-ripeness which would never be approached in normal practice, is remarkably little, and suggests that the degree of over-ripeness normally likely to be reached in factory practice is of little importance.

Preparation with municipal water at the Scott Laboratories was responsible for a little over half a class improvement over that at Kaini estate with Theta River water. Mugutha coffee was a quarter of a class better than Kaini and was more improved by frequent washing at the Scott Laboratories than Kaini coffee.

Further experiments, both in bowls and on a factory scale, were undertaken to see whether under-water fermentation might encourage the production of onion taint. In those on the factory scale, three treatments were given, under-water fermentation with heavy coffee, once washing with heavy coffee and once washing with light coffee. Three replications were given, but on three successive dates. Onion flavour was found in two out of three replications, both with under-water fermented heavy coffee and with once washed light coffee.

It was concluded that two factors are responsible for the production of onion flavour, the first inherent in the coffee as it comes from the plantation, the second a developing factor, which is dependent on the treatment received during fermentation. Prolonged contact with water, as in the underwater fermentation, increases the onion flavour, but even with normal fermentation, it may be produced in coffee which is inherently strongly prone to it.

My thanks are due to the Coffee Board's Liquorer, Mr. Devonshire, who liquored the numerous samples necessary in this investigation.

### **The Measurement of Greenness in the Silverskin**

In past Annual Reports (1944, 1945, 1946), accounts have been given of the method used to estimate the amount of greenness developed in the silverskin of coffee beans and this measurement was correlated with liquor quality, in particular that concerned with the Upper Kiambu characteristic flavour.

The actual calculation of a single value to characterize the development of greenness from the number of beans of four classes—(1) No greenness present; (2) greenness on the lower surface only; (3) green on the lower surface and the part of the upper surface; (4) green all over the bean—was based on empirical determinations of the best correlation given by a number of different methods. The first method used was to take a quarter of the percentage of beans in class 2 and add three-quarters the percentage in class 3 and the whole of that in class 4, it being thought that this would give an estimate of the amount of bean surface in the sample which was coloured green. This measure was termed the "green figure". Later the percentage of beans in classes 3 and 4 was used, since on certain theoretical grounds, this would give an estimate of the average amount of bean surface coloured green, assuming greenness normally distributed. During the preparation of this work for publication, it seemed advisable to check the assumption of normality, if possible.

From the percentage of beans in each class, in cases where greenness is neither very high nor very low, by use of the probability integral and the assumption of normality, three calculations of the mean are possible from three simultaneous equations with two unknowns. These estimates naturally varied between themselves to a degree and the problem was whether these variations were due to a departure from normality in the distribution curve or to observational errors.

A series of skew and kurtosis curves were drawn with the modes at various points in a greenness scale. The percentages falling in each greenness class were obtained by planimeter and the effect of calculating the mean from these figures, assuming normality, was tried. The results showed that the experimentally observed values might possibly have been derived from a skew curve.

The theoretical relation between the proportion in classes 3 and 4 and the mean calculated from the class proportions, assuming normality, was investigated for various types of frequency distribution. The graphs of these functions were found to have an hour-glass shape in the case of skew curves and to be sigmoid for kurtosis and normal curves. In the former, the point of inflection occurred near the middle of the limb whereas with the latter, it was towards the extremes. Curves from actual samples agreed with those theoretically derived from normal curves and this constitutes strong evidence that the distribution of greenness is in fact normal.

The relative merits of the green figures and the percentage of beans with more than half their surface green was investigated by finding their theoretical relation to the mean. This was found to be sigmoid in both cases. The point of inflection for the latter measure was marked and the slope of the main limb more affected by variations in standard deviation. The green figure thus gives the best estimate of the mean, when the standard deviation is unknown. It is even preferable to the arduous calculation of the mean itself, since the latter is very much affected by relatively small errors in the estimation of the percentage of beans in each class. It was found that any attempt to improve the calculation of the green figure by alteration of the constants of  $\frac{1}{4}$  and  $\frac{3}{4}$  for the respective classes would necessitate the calculation of the standard deviation first, a calculation which is open to the same objections as that for the mean. The green figure as originally calculated would thus appear to be the best practical measure of greenness so far obtained.

### Methods of Determining Transpiration

A knowledge of the transpiration of the coffee tree at different times of the year and under various climatic and environmental conditions is of considerable importance for an understanding of the basic physiology of the tree. The study of the transpiration of a large plant such as coffee under natural conditions is beset with difficulties, and so far Nutman's (*vide Annals of Botany N.S.* 5 59, 1941) solution of digging up the entire plant in an undisturbed soil monolith is the nearest solution, though far from ideal. Henrici (*Science Bull. South Africa*, Nos. 142 (1935), 185 (1940), 244 (1946), 247 (1946), 248 (1947) in South Africa has made much use of the rapid weighing of separated branches on a torsion balance, a method which has also been quite widely used by other workers and appears to be due to Stocker (*Jahrb. f. Wissenschaftliche Botanik* 78 p. 750, 1933). There has, however, been some criticism of the method and Homés in the Belgian Congo (*Rapports Annuels pour L'Exercices*, 1947 et 1948, INEAC, Belgian Congo) has found the method unsatisfactory with oil palms. It is extremely rapid and very numerous observations can be carried out with it and if found reliable could be extremely valuable. It depends on the assumption that no significant change of transpiration rate occurs at the moment a twig is cut from a tree nor for about three minutes later. Whereas evidence has been given for the latter assumption, little attention appears to have been paid to what happens at the

moment of detachment, at least as far as woody or mature plants are concerned. In order to test this point with coffee, a divided air stream apparatus was set up which by the use of flowmeters allowed equal amounts of air to pass through absorbing bottles, one current directly and the other after having passed over a leaf enclosed in a cellophane envelope. After three minutes, the two sets of absorbing bottles were switched out of the air current and the leaf was severed. After a further one minute, during which the same rate of air-flow was maintained over the leaf, two further sets of bottles were switched in for three minutes absorption.

Sulphuric acid with sintered bubblers was first tried as an absorbent for moisture, but was found completely incapable of dealing with the rate of air-flow being used (45 litres/hour). Silica gel absorbers were next tried and found much more satisfactory. A peculiar anomaly, so far unexplained, occurred however, the second absorber in the train frequently losing slightly in weight. In view of this, the transpiration rates calculated are perhaps open to criticism, but so far the results would indicate little constant relation between the transpiration rates obtained before and after severing the leaf. It is hoped to carry out further work with better absorbing methods.

### **Growth Observations**

Measurements of extension growth were continued at the Scott Laboratories during the year on the same blocks of coffee as heretofore. Climatic and soil moisture measurements were also continued.

The good rains of 1948, and especially the well distributed and abundant short rains, left the soil with ample reserves of moisture down to the full depth of 15 ft., which is the maximum likely to be used by coffee. This meant that whereas all available soil moisture had disappeared from the top-soil by February the 10th, a rainfall of a little over an inch on this date completely replenished it. However, in the subsequent period there was little rain and by the next effective fall in the second week of April, available moisture had been used up to a depth of 3 ft. Growth in January, February and March was relatively high for this period, reflecting the abundant moisture in the subsoil.

The long rains were poor and available moisture had disappeared from the top-soil by the end of June. There was in consequence a marked, but short-lived growth period, followed by a rapid falling off as the soil dried out and climatic conditions became adverse. Subsequently, except for superficial wetting at the end of August and beginning of September, the soil dried out progressively until only the 15-foot level showed available moisture by the middle of October. The subsequent short rains were only sufficient to wet the top-soil. It was interesting to note that in spite of the top-soil only having available moisture, the rather poor and late short rains produced a very fair growth response.

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## ANNUAL REPORT OF THE AGRICULTURAL CHEMIST (COFFEE SERVICES), 1949

Laboratory work at the Scott Agricultural Laboratories, and field work, both there and at the Coffee Research Station, Ruiru, were continued throughout the year. Transfer to the new laboratories at Ruiru was completed in December. Soil samples were taken on Kitale and Mount Elgon experiments twice during the year, and a tour of the West of Rift coffee areas was carried out during September with the Agricultural Officer. A visit to Solai and Sabukia was made, with other members of the Coffee Services, in September.

The main lines of research have been on the structure and moisture-content of coffee soils under different agricultural treatments; the effects of the availability of water on the response by coffee to fertilizers; the study of the quantitative performance of electrical soil moisture measuring devices and the study of the relations between soil moisture and meteorological observations. Some progress has been made on the study of chemically fortified oil sprays for weed-killing in coffee. A detailed investigation of the relation of water to dry-matter content of both cherry-pulp and bean at different times in the season was made on 80 individual trees at the Scott Agricultural Laboratories. The object was to study the relative accuracy of cherry-weight and clean-coffee-ratio measurements from field trials, and to assess the possibilities, suggested by a small field trial in 1948, of measuring yield on inaccessible experimental plots by a single annual collection of *mbuni*.

### Soil Structural Changes under Cultivation Treatments

A Veihmeyer-type sleeved sampling tool was constructed by a local engineering company, and replaced the more cumbersome steel cylinders used in previous years. Three undisturbed soil cores and two samples for aggregate analysis were taken from each of 27 plots. The samples were taken to a depth of 3 in., since it is the physical condition of the surface soil which is critical for rainfall penetration. A bank of tension tables, of the design published by Jamison and Reed (1949) (Soil, Sci: 67. 311-318) were locally built under E.A.A.F.R.O. arrangements, and have proved highly effective in dealing with large numbers of soil cores. Weights at vacuum-assisted saturation, and after bringing to equilibrium at 50 cm. and 100 cm. tensions respectively, were obtained for all samples. When drainage at 100 cm. tension was complete, they were given percolation tests at 1 cm. head, the volume per minute being read until a steady rate was achieved. The samples were then oven-dried and their real and apparent specific gravities were determined.

Aggregate analyses were carried out as described in detail in the Annual Report for 1948, i.e. by preliminary dry-sieving followed by vacuum-wetting and mechanical oscillation of composite samples assembled in weighted-mean proportions from the dry-sieved fractions.

### The Cultivation and Weed-control Trial

This cultivation trial has been described in detail in the Annual Reports for 1947 and 1949. Three implements, three depths of cultivation, three policies of weed-control and three levels of subsoiling are combined in an 81-plot factorial trial, the plots being split for application of *boma* manure. The cultivations and crop pickings and samplings are carried out by the Agricultural Officer, while the soil sampling, laboratory studies and analysis of soil and crop data are undertaken by the writer.

### Results for 1949—Samples

The data are too voluminous for detailed discussion in this report, but the following tables summarize results which agree in detail with those obtained last year. Each figure in the body of each table is the mean of nine samples.

TABLE I.—TOTAL PORE SPACE AS PERCENTAGE OF APPARENT SOIL VOLUME

|                      | <i>Hand jembe</i> | <i>Disc</i> | <i>Plough</i> | <i>Means for<br/>weed controls</i> |
|----------------------|-------------------|-------------|---------------|------------------------------------|
| Clean weeded .. .. . | 65.7              | 64.1        | 63.2          | 64.3                               |
| Slashed .. .. .      | 66.0              | 64.9        | 64.1          | 65.0                               |
| Tall weeds .. .. .   | 67.4              | 65.8        | 65.2          | 66.1                               |
| Implement means ..   | 66.3              | 64.9        | 64.2          |                                    |

TABLE II.—FREE-DRAINING PORE SPACE (EMPTIED AT 100 CM. TENSION)

|                      | <i>Hand jembe</i> | <i>Disc</i> | <i>Plough</i> | <i>Means for<br/>weed controls</i> |
|----------------------|-------------------|-------------|---------------|------------------------------------|
| Clean weeded .. .. . | 22.2              | 21.1        | 20.1          | 21.1                               |
| Slashed .. .. .      | 25.5              | 23.6        | 20.8          | 23.3                               |
| Tall weeds .. .. .   | 29.7              | 25.8        | 24.6          | 26.7                               |
| Means for Implements | 25.8              | 23.6        | 21.9          |                                    |

TABLE III.—STEADY PERCOLATION IN ML. PER MINUTE

(Through 3 in. diameter undisturbed core.).

|                      | <i>Hand jembe</i> | <i>Disc</i> | <i>Plough</i> | <i>Means for<br/>weed controls</i> |
|----------------------|-------------------|-------------|---------------|------------------------------------|
| Clean weeded .. .. . | 53.3              | 40.5        | 22.5          | 38.8                               |
| Slashed .. .. .      | 54.3              | 45.9        | 32.0          | 44.1                               |
| Tall weeds .. .. .   | 95.0              | 65.0        | 61.2          | 73.7                               |
| Means for Implements | 67.5              | 50.5        | 38.6          |                                    |

It must be remembered that weeding policies are operative only during the long and short rains, all plots being cleaned at the end of the rains. The weedy plots however are left with partial trash cover by the incomplete burial of weeds. There is evidence that the growth of weeds, during the rains, leads to striking and valuable increases in the percolation of water into the soil and in the aeration of roots (Table II), but that this is obtained at the expense of crop yield is shown in the summary of yield figures below. The regular and consistent differences produced by implements and by weeding policies are interesting, and will be discussed in detail when further results have been obtained.

#### Crop Yield Summary

TOTAL YIELD IN LB. CHERRY

|                       | <i>Hand jembe</i> | <i>Disc</i> | <i>Plough</i> | <i>Totals for<br/>weed controls</i> |
|-----------------------|-------------------|-------------|---------------|-------------------------------------|
| Clean weeded .. .. .  | 6,217             | 5,301       | 5,974         | 17,492                              |
| Slashed .. .. .       | 4,312             | 3,935       | 5,131         | 13,378                              |
| Tall weeds .. .. .    | 4,001             | 3,936       | 4,089         | 12,026                              |
| Totals for Implements | 14,530            | 13,172      | 15,194        |                                     |

|                          | <i>Hand jembe</i> | <i>Disc</i> | <i>Plough</i> | <i>Totals for<br/>subsoiling<br/>treatments</i> |
|--------------------------|-------------------|-------------|---------------|-------------------------------------------------|
| Not subsoiled .. ..      | 4,721             | 4,282       | 5,212         | 14,215                                          |
| Subsoiling every 2 years | 4,970             | 4,637       | 5,102         | 14,709                                          |
| Subsoiling every year .. | 4,839             | 4,253       | 4,880         | 13,972                                          |
| Totals for Implements    | 14,530            | 13,172      | 15,194        |                                                 |

|                            | <i>Clean weeded</i> | <i>Slashed</i> | <i>Tall weeds</i> |
|----------------------------|---------------------|----------------|-------------------|
| Not subsoiled .. ..        | 5,485               | 6,737          | 3,993             |
| Subsoiled every 2 years .. | 6,468               | 4,360          | 3,881             |
| Subsoiling every year ..   | 5,539               | 4,280          | 4,153             |

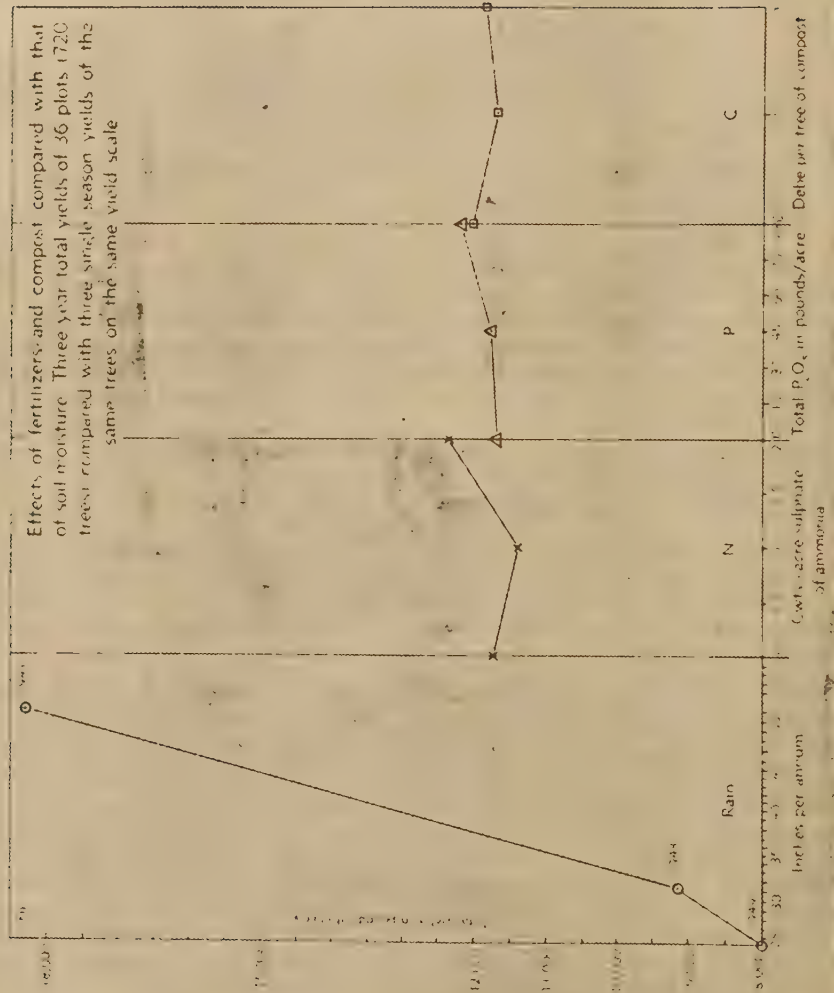
The yield figures on this cultivation trial continue to reflect the seriousness of weed competition during the monsoon rains. The decline in soil structure, over three years of clean cultivation, has not yet reached the point of reducing yields. No crop reduction was attempted, and the trees bore a succession of light flowerings, which the Agricultural Officer picked and sampled in every month from May to the following January. As a result, this trial averaged over  $4\frac{1}{2}$  cwt. clean coffee per acre without showing severe dieback or leaf-fall, on the critically low total of rainfall of 24 in. during the year. The very large number of samples taken exceeded the drying facilities of the factory, and many were hot-air dried as cherry *mbuni* in the laboratory, the clean coffee being adjusted for moisture content after hulling.

As for previous seasons, there are small differences between implements and striking effects of weeds on crop yields. There is no suggestion of benefit from the subsoiling. The formidable volume of crop sampling data will be presented and discussed later, when further statistical studies have been completed as to the best manner in which to use the sampling information.

*Mulch Trial.*—A study of the evidence thus far collected about the relative efficiencies of mulching and composting as uses for vegetable trash in Kenya coffee was published jointly with the Agricultural Officer in the *East African Agricultural Journal* (April, 1950). During 1949 the first stage was carried out towards a comprehensive field trial designed to study the interaction of mulching, composting and the application of nitrogenous fertilizers. Soil samples for structure and aggregation were taken on all plots. The mulch was, however, unavoidably applied late, one month after the end of the long rains, which is a general estate practice since labour then becomes available for this heavy task. The trial was therefore reduced to a well-replicated study of nil, alternate-row and all-row mulch, applied in July. The Agricultural Officer undertook clean-coffee ratio estimates for these three treatments at each picking, so that true estimates of clean coffee yields resulted. The results were a significant 12.9 per cent increase in cherry weight from mulching all rows, but an increase of less than 2 per cent from the alternate row. Large fluctuations in the clean-coffee ratio were found, and the differences were smaller. The results indicate that the time of application of mulch is critical.

Measurements of the penetration of rainfall showed striking improvements under mulch, the differences during wetting of the soil profile extending to greater depths than those found while the soil is drying out during drought. The trial has been fully implemented for 1950, and includes mulches applied both before and after the long rains.





*Manurial Trial.*—This trial has been fully described and discussed in Annual Reports for 1948 and 1949. This third year of exceptional drought gave small chances of fertilizer response under the dominant influence of soil moisture scarcity which is illustrated by Fig. I. A summary of the three years' yields is given below in Table IV.

| Treatment     | n <sub>0</sub> | n <sub>1</sub> | n <sub>2</sub> | p <sub>0</sub> | p <sub>1</sub> | p <sub>2</sub> | c <sub>0</sub> | c <sub>1</sub> | c <sub>2</sub> |
|---------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|
| 1947          | 100            | 96.3           | 100.0          | 100.0          | 98.8           | 100.8          | 100            | 99.2           | 97.9           |
| 1948          | 100            | 101.0          | 112.0          | 100.0          | 108.0          | 103.5          | 100            | 91.8           | 97.9           |
| 1949          | 100            | 93.7           | 112.6          | 100.0          | 98.8           | 113.8          | 100            | 99.0           | 96.8           |
| 3 Year Totals | 100            | 96.9           | 105.7          | 100.0          | 101.6          | 104.5          | 100            | 97.2           | 97.6           |

Nitrogen is giving encouraging signs of a steady response at the 2 cwt./acre level, but there is none from the 1 cwt./acre dressing.

Phosphates have given erratic signs of response, not reaching statistical significance. It is interesting to observe that in the year 1948, when soda phosphate ( $P_1$ ) gave an apparent but not a statistically significant response, a higher level of soluble phosphate was found in the trees for this treatment. In 1949 tissue tests showed  $P_2 > P_1 > P_0$ .

The very considerable mass of data on size and quality factors will be published in a more appropriate place.

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## ANNUAL REPORT OF SENIOR PASTURE RESEARCH OFFICER, 1949

### Main Lines of Work

The investigational work is considered under three main sections as in previous reports. These sections are as follows.

#### Survey

This work is carried out as opportunity permits, which is chiefly in connexion with African settlement and other political problems upon which advice is required. Its aim is to classify the vegetation and demarcate the regions occupied by the major plant communities, in order to provide a basis for regional research in a country which includes a wide range of conditions. With a view to providing a basis for discussion at the inaugural meeting of the East African Advisory Council for Agriculture, Animal Industry and Forestry held in January, the classification obtained in Kenya was extended tentatively to embrace Uganda and Tanganyika, in consultation with representatives of those countries.

In February, a reconnaissance of the Emali-Simba and Masongaleni-Darajani areas was carried out by the Senior Pasture Research Officer. These areas are near to the railway and approximately midway between Nairobi and the coast. The primary object of the work was to recommend upon future utilization under African occupation.

During this period, a survey of the Kiboko tsetse fly experimental area, in the same general region, was completed by Mr. A. V. Bogdan, Pasture Research Officer at the request of the Veterinary Department.

Mr. J. A. Allan, Pasture Research Officer, submitted his report on a preliminary survey of the coastal region in March.

#### Natural Grassland Types

The natural grasslands are associated with five main vegetational regions—highland grassland and forest, scattered tree grassland (low tree—high grass), coastal high grass-bush, scattered tree grassland (*Acacia-Themeda*) and semi-desert grassland, comprising desert grass-bush and desert scrub. Each type of grassland presents a different set of problems which must be studied by means of a station within the region concerned, and the establishment of five such main stations is the accepted plan for development. The stations are, however, not yet in existence, and it has been necessary to continue work on the lines indicated in previous reports. Certain urgent problems of management in the areas of European settlement have been attacked by means of co-operative experiments on farms and in collaboration with district field staff.

Such co-operative experiments and the stage of progress reached are as follows:—

(1) Investigation of the problem of grass burning in the *Acacia-Themeda* grassland at Ngong. Here the dominant *Themeda triandra* has been maintained by annual burning and suppressed by the exclusion of fire both with and without grazing treatments. No further results are yet available.

(2) In the transitional zone lying between the true highland grassland and the *Acacia-Themeda* vegetation, an experiment near Thomson's Falls is designed to discover methods of suppressing the useless coarse-grass phase dominated by *Pennisetum schimperi* which tends to replace desirable *Themeda* herbage. This trial has confirmed that the coarse-grass phase can be controlled by the periodical use of fire in herbage accumulated by protection from grazing, but this is necessarily a method applicable only to extensive management and under the rainfall of the area (35 in. per annum) more intensive methods are indicated. Higher production could certainly be attained over much of the region by the adoption of ley farming. There appears,



therefore, to be little point in continuing this experiment. The answer to the *Pennisetum schimperi* problem here is intensification of management, although it is appreciated that the nature of the terrain in some cases permits only of ranch practice.

(3) Work on the deteriorated *Cynodon* (Star grass) pastures of the Rift Valley was continued near Elmenteita. These natural pastures are situated on old lake beds and as a result of mismanagement, accentuated in recent years by drought, a widespread tendency has occurred for the dominant *Cynodon* to be replaced by *Aristida adscensionis*, an annual grass of low grazing value which is particularly troublesome in sheep farming owing to the penetration of the wool and even the hides by the sharp fruits of the grass. The experiment is in its third year and the main results to date may be summarized as follows:—

- (a) Continuance of permanent grazing by sheep (1.3 acres per head) has maintained the *Aristida*.
- (b) Permanent grazing by cattle (6.7 acres per head), i.e. removal of sheep, has resulted in a significant reduction of *Aristida*.
- (c) The following treatments have all resulted in improvement by a clear reduction of *Aristida*.
  - (i) Complete exclusion of grazing.
  - (ii) Heavy grazing with cattle (3 acres per head) in the dry season.
  - (iii) Light grazing with cattle (15 acres per head) in the dry season.
  - (iv) Grass burning both before and after seeding of *Aristida* (no grazing).
  - (v) Mowing both before and after seeding of *Aristida* (no grazing).

#### Temporary Leys

The aim of this section of work is to provide pasture plants for use as temporary leys in the arable rotation. The adoption of ley farming in the crop-producing areas is an urgent necessity in view of the rapid deterioration of soil structure under local conditions, and its relationship to absorption and retention of water and to soil erosion. Development in the desired direction is as yet limited; in the areas of European settlement chiefly on account of the high cost of the implied change to intensive methods of farming and in the regions densely occupied by African agriculturists because of deeply rooted custom in addition to cost. A considerable demand for seed of the three grasses already in practical use has arisen in the European areas in recent years. These grasses are the Nzoia Strain of Rhodes grass (*Chloris gayana*), Molasses grass (*Melinis minutiflora*) and *Bromus marginatus*, one or other of which can be used in any of the various crop-producing areas. All three grasses are in commercial supply, seed production having been effected through selected growers. In the case of Nzoia Rhodes grass, however, supplies were again insufficient to meet the demand. This was due in part to the unsatisfactory performance of growers and difficulty in regard to suitable harvesting machinery, but the demand for this seed is also greater since the grass is capable of wider use than the other two species.

Throughout the work, attention has been mainly directed to the indigenous flora which presents a wide field for investigation. Practically all the commercially available pasture species are of temperate origin, and experience has shown that only within a very limited region at the highest elevations of settlement is there a chance of the success of these species.

In the search for suitable indigenous grasses, the two qualities which have presented most difficulty are seed production and ability to persist under intensive management. Five grasses were mentioned in the 1948 annual report as having reached the stage of bulking for further work. These are *Pennisetum stramineum*, *Cenchrus ciliaris* (erect form), *Setaria* (?) *sphacelata* ex Nandi, the Chania River

Ecotype of *Melinis minutiflora* (Molasses grass) and the Alego Strain of *Chloris gayana* (Rhodes grass). Further species which have given promise under preliminary observation during the year are:—

*Beckeropsis uniseta*.

*Andropogon schinzii*.

A form of *Cynodon plectostachyum* (Star grass).

*Cypholepis jemenica*.

*Hyparrhenia lintonii*.

*Leptochloa obtusiflora*.

*Sporobolus helvolus*.

Mention should be made of what may prove to be another Rhodes grass type of value. Material has been increased from a single, leafy plant of distinctly different appearance observed in a seed production plot of the Nzoia Strain. This new material is exceptionally vigorous and leafy but, so far, difficulty has been encountered in regard to seeding qualities.

In order to obtain definite records of the performance of temperate pasture species at high elevations, experiments were continued at the Agricultural Station, Ol Joro Orok (7,800 ft. altitude and 35 in. rainfall). This station is situated in a transitional zone of vegetation, and field observational trials were therefore extended to the true Highland Grassland vegetation at Molo and the Kinangop.

A statistically arranged experiment including five British grasses, one sub-tropical species and two indigenous grasses is now in its second year. A comparison of yield and persistence is being made by means of monthly cuts. The grasses are—Perennial Rye Grass, Cocksfoot, Creeping Red Fescue, Crested Dog's Tail, Timothy, *Bromus marginatus*, *Snodonia* sp. (Abyssinia grass) and the Nzoia Strain of *Chloris gayana* (Rhodes grass). *Bromus marginatus* (of sub-tropical origin) is of proved value in the high-altitude regions and Nzoia Rhodes grass has already been referred to as the chief ley grass of a wide agricultural region at lower elevations; its value above about 6,500 ft. has however, not hitherto been contemplated.

The results of this experiment to date may be summarized as follows:—

Nzoia Rhodes grass gave very promising results. It was somewhat slow to establish under the conditions and weed growth might prove to be a difficulty, but it gave the highest yield in the second year, produced a good sward and was frost resistant (*see* 1948 Report). It tolerated drought best of all the grasses.

*Bromus marginatus*, already in practical use as a ley in the region, gave yields inferior to those of Nzoia Rhodes grass in the second year.

Abyssinia grass gave the greatest yield in the first year and then fell in the second year to well below that of the two foregoing grasses. The indications are that it is of value only as a very short duration ley.

All the British grasses, although they became established, either made insignificant growth or produced yields well below those of Nzoia Rhodes grass and *Bromus*. Cocksfoot gave the best yield, but it came into production only in the second year. This is not surprising since the strain used was slow-growing (Aberystwyth S. 143). The species appears to merit further trial. Perennial Rye grass also grew moderately well in comparison with the other British species, but its drought resistance was poor. The remaining three British grasses proved unable to give yields of any consequence and are obviously useless under the conditions of the experiment.

The extension of this work to farms in the Molo and the Kinangop high-elevation-better rainfall areas in collaboration with the District Agricultural Officer took the form of twice replicated, one-eighth acre observational plots which it is

proposed later to subject to grazing treatment. Unfortunately, Nzoia Rhodes grass was not included in these trials. Sowing was carried out in June, 1949, and only preliminary observations can yet be made. These indicate as follows:—

The control of weeds by means of frequent mowing was necessary in the early stages of establishment. *Bromus marginatus* developed most quickly and produced a good sward with weeds under control.

Perennial Rye grass also made a successful establishment and was in condition for grazing somewhat later than the *Bromus*.

Cocksfoot succeeded in establishing itself and formed a sward, but in this first year growth was extremely small. Timothy (as at Ol Joro Orok) and Meadow Fescue were failures.

In addition to the above work, observational plots of the following exotic and indigenous grasses were sown at Ol Joro Orok in 1948 and 1949 with the undermentioned results:—

Veldt Grass (*Ehrharta calycina*), 1948.—Promising, withstands drought and frost, set seed.

Smooth Stalked Meadow Grass, 1948.—Failure.

Kentucky 31 Fescue, 1948.—Promising, good establishment, rapid growth, frost and drought resistant, free seeding.

Good results also obtained at Molo.

New Zealand Tall Fescue, 1949.—Initial promise followed by very slow growth.

*Acrocerus macrum* (roots) 1948.—Very slow growth under the conditions.

*Setaria sphacelata*, 1948.—Promising, good bulk, set seed.

Molasses grass (*Melinis minutiflora*), 1949.—Poor growth, apparently unsuited to the conditions.

### Legumes

Extensive collection of indigenous legumes was carried out during the year by the Pasture Research Officer at the Scott Agricultural Laboratories and trials of numerous species have been initiated. Plants which have given distinct promise in the early stages of this investigation, and which are in addition to those mentioned in previous reports are *Alysicarpus glumaceus* and *Indigofera retroflexa*.

In connexion with the trials of British grasses at high elevations described above, a series of exotic clovers was also placed under experiment. Of the perennials, at Ol Joro Orok only Dorset Marigrass clover has persisted and given some degree of promise, while Ladino clover, three varieties of Wild White and Late Flowering Red clover failed to persist to the second year, having largely given way to competition by *Trifolium johnstoni*, the common indigenous clover of the region. A similar result was obtained in the case of Wild White clover included in the extension of the trials to the better rainfall, high areas of Molo and the Kinangop. It has been observed in previous reports that the necessity of providing a pasture legume for ley farming in these high regions is very doubtful, since indigenous *Trifolium johnstoni* is usually plentiful where short herbage occurs, and it can be induced to appear in sufficient quantity by suitable grazing management.

In general, it may be observed that at the present stage of development in Kenya it might be well to avoid too slavish an acceptance of the recognized importance of legumes in the agriculture of developed, temperate countries. There is clear evidence locally that soil fertility is enhanced by cover and also that the yield of grass may be favourably influenced by associated legumes. Further, the beneficial effect upon nutrient status of the pasture may be taken for granted to some extent, but in present circumstances, if the means to grow even a vigorous



single species ley can be provided and farmers, European and African alike, can be induced to use the material, then the most important step towards solving the critical problem of soil deterioration will have been taken and the food supply of the animal will have been improved far beyond that which is available under present conditions of farming. In short, the provision of pasture legumes may be regarded as of secondary importance, in view of the urgent necessity to bring about a change of method towards the use of any temporary pasture in the arable rotation of crop-producing areas.

### Lawn and Sports Grasses

In the European areas of Kenya there is a considerable demand for turf-forming grasses suitable for lawns and sports grounds. In the absence of other agencies, the provision of such material has fallen upon the Pasture Research Section. Again the well-known grasses of temperate countries have proved a failure, and it has been necessary to utilize indigenous material obtained either locally or from neighbouring territories. Stolonerous species are the most successful and ability to produce seed is of less importance than in the case of agricultural grasses, since relatively small areas are involved.

In the Highland Grassland and Forest region upwards of 6,500 ft. elevation with 40 in. or more rainfall, Kikuyu grass (*Pennisetum clandestinum*) occurs naturally and the establishment of lawns presents little difficulty. The tendency of the grass to form a spongy turf unless carefully managed is, however, a drawback to its use for both lawns and sports grounds. At lower elevations Kikuyu grass cannot be used successfully and the main type upon which these areas now depend is *Digitaria swazilandensis* (Swaziland grass). This grass was first included in the work in 1934, when it was received amongst a series of *Digitaria* species from the Department of Agriculture, Pretoria. Its value as a lawn and sports grass was later proved and in recent years it has been in commercial supply. The grass is now very extensively used as a lawn. In the coastal tropical belt a small variety of *Cynodon dactylon* which occurs locally is, so far, the only type which has given moderately good results.

Less progress has been made with the more specialized requirements of golf greens. Grass greens are possible only in the better rainfall areas, and with relatively few exceptions golf clubs make use of sand areas locally known as "browns". In the Highland Grassland region Kikuyu grass is used, and by means of careful top dressing with soil and organic matter it gives a moderately satisfactory surface, although the leafage is coarse in comparison with the accepted types of temperate countries. In the lower and somewhat drier regions local varieties of *Cynodon dactylon* and a *Cynodon* hybrid (Bradley grass) obtained from South Africa are used to a limited extent. The latter is successful only where an ample water supply can be laid on to the greens for use in the dry season. A member of this group which shows considerable promise for the purpose in view has recently emerged from the work. This is a miniature form of *Cynodon dactylon* of marked drought resistance and with distinctly hard, narrow leaves. It is known as the Madi River variety and was originally obtained from South Africa through the African Explosives and Chemical Industries, Ltd.

### Crops for Fodder Storage

Yield trials of a range of crops intended as reserve fodder were continued. The demand for seed of Improved Kavirondo Sorghum, R2S42, bred at Kabete, increased considerably amongst European farmers during the year, and the crop is now used fairly extensively although the fact that it is intended primarily for ensilage in marginal regions of erratic rainfall does not appear to have been fully appreciated. Numerous mentions of this Sorghum have appeared in British and colonial journals. The provision of a seed supply has presented some difficulty, since the grower mentioned in the 1948 report has functioned very indifferently, a large proportion of the crop having been lost through the depredations of birds.

### Identification of Pasture Plants

Work on the grass flora of Kenya was continued by the Pasture Research Officer at the Scott Agricultural Laboratories. Some 600 specimens were collected and 74 grasses and 50 legumes and sedges were submitted to the Royal Botanic Gardens, Kew, for verification. The list of indigenous grasses now consists of 430 species.

As the result of survey work and the submission of material by departmental officers and farmers, 410 specimens were identified during the year. A collection of 60 more common and important grasses was supplied in response to a request from Purdue University, United States of America.

### Exchange of Plant Material with Countries Abroad

Planting material was supplied on request to the following countries:—

Tanganyika, South Africa, Sudan, Israel, Southern Rhodesia, Swaziland, Nigeria, Indo China, Ethiopia, Belgian Congo, Northern Rhodesia, Venezuela, Australia and Nyasaland.

Material was received from Uganda, United States of America, South Africa and Australia.

### Publications

Publications during 1949 were as follows:—

Conservation of Vegetation in East Africa.—D. C. Edwards. Paper contributed to International Soil Conservation Conference, Belgian Congo, 1948.

The Vegetation in Relation to Soil and Water Conservation in East Africa.—D. C. Edwards. Article contributed to Bulletin 41, Commonwealth Bureau of Pastures and Field Crops, Great Britain.

Important Grassland Plants of Kenya.—D. C. Edwards and A. V. Bogdan. Book in the press, Pitman and Sons Ltd., England.

Key to Kenya Acacias.—A. V. Bogdan. Nature in East Africa, Series 2, No. 1, May 1949.

Observations on Palatability of some Leguminous Plants of Kenya.—A. V. Bogdan. *East African Agricultural Journal*, Vol. XV, No. 1, July, 1949.

Two Species of Star Grass in Kenya.—A. V. Bogdan. *East African Agricultural Journal*, Vol. XV, No. 2, October, 1949.

D. C. EDWARDS,  
*Senior Pasture Research Officer.*

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## **ANNUAL REPORT OF THE AGRICULTURAL OFFICER (HORTICULTURE), 1949**

### **PART I—GENERAL ADMINISTRATIVE AND EXTENSION WORK**

#### **Horticultural Training**

There is a demand on the part of growers, municipalities, etc., for Africans with horticultural training; with this in view it was decided to accept a few Africans for horticultural training at Molo. The course lasts one year, and is essentially a practical one. It is hoped to extend the course to the Matuga Station later.

#### **Extension Work**

A large volume of advisory correspondence was dealt with during the year. Personal visits were paid to most districts for the purpose of advising growers.

#### **Agricultural and Horticultural Shows**

Exhibits were staged at the Royal Agricultural Society's Show in Nakuru, and at the Kenya Horticultural Society's Show in Nairobi.

One permanent exhibit, representing an irrigated citrus grove, laid out on graded bench terraces, was loaned to the Egerton School of Agriculture.

#### **Field Days and Demonstrations**

A Farmers' Day, for both horticultural and pyrethrum growers, was held at Molo in October, about 50 growers attended. The principal points demonstrated were, the effects of oil sprays in breaking the dormancy of deciduous fruit trees, and pruning of fruit trees.

Two demonstrations of grafting, pruning and spraying were held at Molo for the pupils of the Egerton School.

#### **Publications**

Two articles, illustrating work carried out at this station on strawberries and pear drying, were written for the "Annual Review".

#### **Meetings**

Several meetings of the Seeds Section Committee and the Horticultural Committee of the Kenya National Farmers' Union were attended during the year.

#### **The Horticultural Industry**

An important development for the industry was the formation in August of the Horticultural Industry Committee of the Kenya National Farmers' Union.

The Committee is made up of 12 growers, the Agricultural Officer (Hort.) and the Executive Officer, Kenya National Farmers' Union.

The terms of reference of the Committee are as follows:—

"To consider and, if thought fit to recommend action for developing the horticultural industry in respect of both production and marketing."

The Committee has held several meetings, and is at present holding meetings with a Committee appointed by Government to consider the setting up of a producer controlled co-operative marketing organization for horticultural produce.

The Committee have asked the Horticultural Section of this Department to conduct a survey of the horticultural industry in order to find out what quantity of produce a marketing organization would be likely to handle. The survey will be carried out early next year and, it is hoped, will give a reliable picture of the development of the horticultural industry.

#### **Fruit and Vegetable Processing**

Several canneries were under construction during the year, and are due to start production in 1950.



Shortage of planting material is still holding up the planting of pineapples for canning. It seems unlikely now that appreciable supplies of pineapple suckers will be available from outside Kenya, and we shall have to rely chiefly on the natural increase of our own supplies.

### Fruit Crop, 1949-50

The season's fruit crop has been variable, chiefly due to the very dry season experienced in some parts of the country. Crops in Molo and surrounding districts are good. The pear crop is particularly heavy. The Kinangop has a fair crop of apples. Limuru crops were very poor, owing to drought, although the trees flowered well, much of the crop failed to set.

### Seed Crops

Vegetable seed crops, mostly peas, were better than last year, owing to the drier season. Lack of seed growing experience, and poor farming have resulted in the loss of many crops which would otherwise have resulted in a profit to grower and contractor.

### Importation of Fruit Trees

The following table gives the figures for importation of fruit trees, and other plants through Kilindini for the past four years.

The last column gives the estimated acreage of fruit trees planted with imported trees.

#### FRUIT TREES

| Year    | No. of Packages | Value in Sh. | Acres |
|---------|-----------------|--------------|-------|
| 1946 .. | 301             | 43,380       | —     |
| 1947 .. | 344             | 58,451       | —     |
| 1948 .. | 426             | 71,640       | 240   |
| 1949 .. | 556             | 68,523       | 228   |

#### OTHER PLANTS

| Year    | No. of Packages | Value in Sh. |
|---------|-----------------|--------------|
| 1949 .. | 101             | 27,332       |

### Importation of Fresh Fruit

The following table gives the figures for importation of fresh fruit through Kilindini for the past four years.

| Year       | Country of Origin   | No. of Packages | Value in Sh. | Kind of Fruit |
|------------|---------------------|-----------------|--------------|---------------|
| 1946 .. .. | E.A. Territories .. | 69,954          | 548,941      | Mixed         |
|            | South Africa ..     | 20,054          | 687,974      | "             |
| 1947 .. .. | E.A. Territories .. | 14,811          | 116,015      | "             |
|            | South Africa ..     | 28,356          | 670,067      | "             |
| 1948 .. .. | E.A. Territories .. | 20,218          | 139,484      | "             |
|            | South Africa ..     | 28,913          | 541,645      | "             |
| 1949 .. .. | E.A. Territories .. | 21,250          | 202,754      | "             |
|            | South Africa ..     | 13,553          | 320,783      | Apples        |
| 1949 .. .. | South Africa ..     | 20,850          | 322,032      | Mixed         |
|            | Australia ..        | 1,681           | 52,488       | Apples        |

The total value of fresh fruit imported during 1949 was Sh. 898,057; this shows an increase in value of Sh. 216,928 over 1948 importations.

These figures indicate that there is a considerable demand for fresh fruit in Kenya which is not being met by local production. When new plantings come into bearing there is likely to be considerable competition between local and imported fruit.

### Matuga

This station is situated at the new Department of Agriculture farm on the Coast, at about 10 miles from Likoni ferry on the Kwale Road. It was decided that a part of the work at this station would be the development of a commercial sub-tropical fruit nursery. Details of development at Matuga are given below as a separate report by A. C. Howden, Assistant Agricultural Officer (Hort.):—

“Sub-tropical fruit nurseries were started at Matuga in January, 1949, and seed of different varieties of fruits was obtained in the Colony and planted.”

### Citrus

Rough lemon fruits were collected from Taveta, Lemon Hybrid from Malindi and Zanzibar Orange from Mtwapa Creek. All seed from the above was extracted and planted for root-stocks. Germination and growth in seedbeds was good. The seedlings were all duly culled and only the most vigorous planted in nursery rows; approximately 4,000 ultimately being planted out. Growth again was excellent, all seedlings reaching budding size in nine months.

A few budded trees were found at the Vipingo Sisal Estates and these were used as a source of budwood. Budwood of the following varieties was cut: Valencia Late, Local Muheza, Ruby Blood, Villa Franca Lemon, Marsh seedless grape fruit, and Triumph seeded grapefruit. Only a few small parcels of budwood were cut from this source as the trees are not under irrigation and during the drought were soon wilting and bark bound. A good “take” was, however, obtained from the budwood cut. Budwood was then ordered from South Africa but owing to some delay only started arriving in the country in January. The budding has not been very successful in the orange varieties owing to the extremely dry north-east monsoon, and the water supply drying up. The lemons budded, on the other hand, were good. Where the stocks should have had a bi-weekly or weekly irrigation during the budding period only a monthly irrigation was possible.

Seven-thousand stocks were planted in nursery rows but planting was then held up owing to unfavourable weather conditions and shortage of water. The stocks planted out have made very little headway and will have to be replanted in the new nursery as soon as the water supply is through or the long rains begin.

There are still approximately 5,000 seedlings in seedbeds that are being kept irrigated by watering cans.

A mother garden for our own source of budwood has been established and the young trees are doing well.

The following varieties have been planted:—

| <i>Ex Kitale</i>   | <i>Ex South Africa</i>   | <i>Ex Kibarani</i> |
|--------------------|--------------------------|--------------------|
| Renmark Navel.     | Eureka Lemon (all dead). | Triumph good fruit |
| Washington Orange. | Triumph good fruit       | (seeded).          |
| Temple Orange.     | (seedless).              | Eureka Lemon.      |
| Lue Gim Gong.      | Triumph good fruit       |                    |
| Hamlin.            | (seeded).                |                    |
| Sabina (all dead). | Empress Mandarin         | <i>Ex Nairobi.</i> |
|                    | (naartje).               | Meyer Lemon.       |
|                    | Valencia Late.           |                    |
|                    | Washington Navel.        |                    |

Pests throughout the year have been very troublesome owing chiefly to the favourable weather conditions for breeding. A very heavy infestation of citrus aphids made an appearance in September, but were successfully controlled by nicotine spraying. "Red Spider" has spread alarmingly and a double dusting of sulphur plus a lime sulphur spraying has had no effect. An oil spray at 2 per cent strength is now being tried and it is hoped that the infestation will be checked. The knapsack spray pump in use is, however, inadequate for the work as a high pressure is needed for oil sprays. The "Orange Dog" caterpillar is being successfully controlled by hand, resulting in very little damage being done.

*Pineapples*.—A few hundred smooth Cayenne suckers were obtained from Mtwapa Creek and considering the adverse weather conditions have done fairly well; a few of the more advanced plants have started fruiting.

*Coconuts*.—Three thousand coconuts from a good strain were obtained from Roka and germinated well, most of them have been planted out on bench terraces around the nursery site. A small parcel arrived from Ceylon but have not yet germinated.

*Avocados*.—The Mexican seed which arrived from Nyeri has been a complete failure. Germination was good in seed beds, but since being transferred to nursery rows growth has been indifferent and they have practically all died back.

*Passiflora Edulis*.—The passion fruit seed sent down by the Agricultural Officer, Molo, germinated well and growth in seed beds was exceptionally good. They were duly planted out but the drought and a heavy infestation of "nematodes" has resulted in them all dying. Another trial under better irrigation conditions will be worth while.

*Mangoes*.—Very little has been done in this line. The first planting of "Dodo" mangoes for rootstocks was a failure, as, owing to the "Mango Weevil" a very low germination was obtained from the seed planted. A few trees of the varieties "Boribo", "Peach" and "Sabre" have however been established.

*Pawpaws*.—Seed of "Hortus Gold" and "Hawaiian Strain" was planted and the latter germinated well, but a very poor germination was obtained in the "Hortus Gold" seed received from South Africa. Since being planted out the drought has taken heavy toll and the few left are very stunted.

*Gooseberries*.—A parcel of Cape Gooseberry plants arrived from up-country and considering that no water was available for irrigation, have done well. In my opinion this crop can be successfully grown at the coast under favourable conditions.

*Bananas*.—Different varieties of suckers were obtained from Taveta and local growers and planted near the swamp in the nursery. Growth has been excellent and a few varieties have started fruiting.

*Other Tropical Fruits*.—Seeds of Sapodilla, Kola Nut, Cacao, Carambola and Custard Apple were sown, and a few trees of each variety have been planted along contour ridges in the nursery.

*Trees and Ornamentals*.—A wide selection of flowering tree and shrub seeds were sown and later planted in nursery rows. Growth has been very slow owing to unfavourable weather conditions.

### Ol Joro Orok

A new layout to enable irrigated fruit trees to be compared with unirrigated, necessitated the replanting of the Ol Joro Orok experiment orchard; this was done in July. The 4-in. irrigation pipeline is now complete and the irrigation system is working according to plan.



### Kitale

Bench terracing of the 5-acre plot on the Prison Farm was carried out by the Soil Conservation Service.

### Jacaranda

Development of this station is held up for lack of funds. Some work is in progress on the rooting of Hop cuttings.

Trials of tomato varieties for canning were started at the end of the year.

### Seed Cleaning Plant

The seed cleaning plant was operating in the Pyrethrum Board building at Nakuru until May.

The plant has now been taken over on loan by Molo Industries, Ltd., and is operated entirely by them at Molo.

## PART II—RESEARCH AND INVESTIGATION

### Tree Fruits

#### *Apple Rootstocks*

Gravenstein apples grafted on to the following East Malling rootstocks are making growth comparable to Gravenstein grafted on seedling crab rootstocks:—

E.M. XIII.

E.M. Immune 10.

E.M. Immune 12.

E.M. Immune 411.

Of the four rootstocks above, Nos. 10 and 12 are by far the easiest to propagate, and it is probable that only these two would be of use commercially. Stocks of Nos. 10 and 12 are being propagated as rapidly as possible in anticipation of their issue to local nurserymen.

In the nursery, scion wood of the varieties, White Winter Pearmain, King of Tomkin's County, Gravenstein, and Jonathan were grafted on to rootstocks of Northern Spy, Cape Seedling, M10, M12, and Seedling Crab. These are the combinations required for the statistical rootstock experiment. The scion wood was imported from England, in order to make sure that it was true to name, it was however, of very poor quality and only in small quantity. A consignment ordered from South Africa failed to arrive at all. For the above reasons, the number of trees required for the experiment have not been raised, and it will be necessary to regraft in 1950, using local scion wood.

#### *Top Working*

Trees of unsatisfactory varieties in several private orchards have been top worked to proved varieties by the frame working method. The method is to retain enough of the original main branches of the original tree to provide the framework of the new tree. Grafts are inserted at intervals into lateral shoots arising from the main branches. As many as 86 grafts were inserted into one tree which had a large framework. The new shoots from the scions come into bearing after one or two seasons. The variety Ohinemuri, of which there are many trees in local orchards, is a suitable subject for top-working as it makes a large tree, but the fruit suffers severely from physiological cracking.

#### *Yield Records*

The following table gives the yield and growth records to date, of some of the varieties in the Molo experiment orchard. The trees are, of course, only just coming into bearing, but it is thought that the figures may be of interest to growers in indicating what crop may be expected from young trees. For each variety, or combination of variety and rootstock, the figures are the average of four trees.

## YIELD AND GROWTH RECORDS

| Kind  | Variety         | Rootstock | Planting Date | Growth M.<br>Date 26-7-49 |                 | Crop<br>average of<br>4 trees<br>season<br>1948/49<br>lb. | Crop<br>average of<br>4 trees<br>season<br>1949/50<br>lb. |
|-------|-----------------|-----------|---------------|---------------------------|-----------------|-----------------------------------------------------------|-----------------------------------------------------------|
|       |                 |           |               | Height<br>ft. in.         | Span<br>ft. in. |                                                           |                                                           |
| Peach | Alexander Jewel | Peach     | 1946          | 10 8                      | 6 8             | 16.6                                                      | —                                                         |
| Peach | Muir            | Peach     | 1946          | 8 0                       | 6 3             | 2.2                                                       | —                                                         |
| Peach | Angel           | Peach     | 1946          | 11 1                      | 8 7             | 12.2                                                      | —                                                         |
| Plums | Apricot         | Mariana   | 1946          | 7 8                       | 6 8             | 7.40                                                      | 50.36                                                     |
| "     | Methley         | Mariana   | 1946          | 6 2                       | 5 2             | 0.65                                                      | 15.20                                                     |
| "     | Methley         | Peach     | 1946          | 6 3                       | 5 0             | 7.20                                                      | 29.00                                                     |
| "     | Tazagine        | Mariana   | 1946          | 6 8                       | 5 3             | 1.85                                                      | 19.81                                                     |
| "     | Tazagine        | Peach     | 1946          | 6 9                       | 5 1             | 1.3                                                       | 6.18                                                      |
| "     | Shiro           | Mariana   | 1946          | 7 7                       | 4 5             | 0.85                                                      | 8.62                                                      |
| "     | Shiro           | Peach     | 1946          | 7 6                       | 5 1             | 0.25                                                      | 2.12                                                      |
| "     | Wilson          | Mariana   | 1946          | 8 7                       | 5 1             | —                                                         | 2.20                                                      |
| "     | Settler         | Mariana   | 1946          | 10 2                      | 6 9             | 0.9                                                       | 8.68                                                      |
| "     | Jardines Early  | Peach     | 1946          | 7 6                       | 5 2             | —                                                         | 3.12                                                      |
| "     | Jardines Early  | Mariana   | 1946          | 9 6                       | 7 7             | —                                                         | 3.94                                                      |
| "     | Beauty          | Mariana   | 1946          | 8 2                       | 3 3             | —                                                         | 2.50                                                      |
| "     | Duarte          | Own roots | 1947          | 8 2                       | 3 4             | —                                                         | 1.43                                                      |
| "     | Satsuma         | C 1       | 1947          | 5 8                       | 2 7             | —                                                         | 0.62                                                      |

*Pear Drying*

Experiments on drying Keiffer pears form the subject of an article published in the "Annual Review", therefore, a brief report only is given here. Keiffer pears were first cut and trayed, then sulphured, and dried in a pyrethrum drier. The dried product was attractive in appearance and flavour, and kept well. As there is often a surplus of Keiffer pears, drying should provide a useful outlet. The sulphuring process is essential to success. The whole process can be carried out on the farm with inexpensive equipment.

*Nutrition*

As stated in the Annual Report for 1948, leaf symptoms, particularly on apples, of what appears to be magnesium or potash deficiency, are serious on trees at Molo, and are extremely widespread throughout Kenya, in apple orchards. The symptoms are, a chlorosis and necrosis of the leaf, starting with the lowest leaves on the current season's growth and spreading to the upper leaves as the season advances. The lower leaves are shed prematurely.

A trial was started with sulphate of potash as a soil dressing, in 1948; no improvement in the condition was observed. Early in 1949 leaf injection with solutions of potash, magnesium, and various other elements was tried. Injection with solutions of the same strength as used for this work in England produced a lethal effect on the leaf tissues. When the strength of the solutions was reduced to 50 per cent or 25 per cent there was no observable reaction at all.

It was decided to increase the scope of the soil dressing trial, and the following treatments are now carried out on a total of 74 apple, pear and plum trees:—

1. K, Sulphate of Potash, soil dressing at 15 oz. per tree.
2. Mg, Magnesium Sulphate, soil dressing at 8 oz. per tree.
3. Mg+K, Sulphate of Potash 15 oz. per tree, soil dressing Magnesium Sulphate 8 oz.
4. Mg, Magnesium Sulphate, foliage spray, 2 per cent solution in water.
5. Control, Untreated.

The soil dressings were broadcast on the surface of the soil over an area of 81 sq. ft. round each tree, and afterwards worked into the surface soil. The soil dressing treatments were carried out on the 16th May, 1949.

The Magnesium foliage spray treatment was carried out by wetting all the foliage on the treated trees by means of a small spray pump. This treatment was

first carried out on 9th November, 1949, and was repeated on 9th December, 1949, 6th and 23rd January, 1950, 11th and 25th February, 1950, a total of six applications. Observations on foliage symptoms of the trees in the trial have been made at intervals of a few weeks since the treatments were carried out.

Although the experiment will have to be continued for several seasons to obtain conclusive results, the following reactions to the treatments have been noted to date:—

1. K—symptoms increased over Control trees.
2. Mg—symptoms very much decreased.
3. Mg + K—results inconclusive, but symptoms tend to be less than on Control trees.
4. Mg (foliage spray)—symptoms decreased more than by treatment 2 and in a shorter time.

The above results indicate that the deficiency is of magnesium and not of potash. Not only are symptoms decreased by both the magnesium treatments, but they are increased by the potash treatment. The latter reaction would be expected in the presence of a deficiency of magnesium.

#### *Prolonged Dormancy.*

A considerable part of the deciduous fruit acreage was oil sprayed this year by growers. Extensive trials were carried out at Molo, using four proprietary oil sprays. The best reaction with plums was obtained by spraying between the 16th and 24th of August. For peaches the best date is about August 31st, whilst apples react best to spray in the first week of September. These dates are approximately the same as those which gave the best results last year. It has not been possible yet to correlate the effects of spraying with yield of fruit as the trees at Molo are only just coming into bearing; it may be possible, however, to obtain some figures next season.

One effect of oil spraying with plums is to reduce the time over which the crop is harvested, often by about two weeks. This of course reduces picking costs as the trees have to be picked fewer times to complete the harvest. The work carried out this year confirms that of last year; trees sprayed at the right time—this is most important—opened their blossom and leaf buds more regularly, in larger numbers, and earlier than unsprayed trees, or trees sprayed at the wrong time.

Every grower of deciduous fruit should spray all plums, apples, and pears every year.

### **Berry Fruits**

#### *Strawberries*

The work on strawberries has been reported in detail for the "Annual Review", and will be mentioned only briefly here.

Royal Sovereign, M40, imported from England is promising at Molo, trials by private growers indicate that this variety may not be suitable for warmer climates. The Melba strawberry does not appear to be well suited to high altitudes but does well in warmer districts, such as Turbo. The yield from a plot at Molo worked out at 518.5 lb. per acre for the 1949/50 season, but this figure would have been higher if it had been possible to irrigate throughout the dry season.

#### *Youngberry*

It has been discovered that Boysenberry plants planted at Molo in 1947, were received wrongly named from the nurseryman, and are in fact Youngberry. Although Youngberry have done fairly well, it is evident now that they require rich soil and irrigation, if really good results are to be obtained. The plants will be moved to a more suitable site in 1950.



### Seedling Raspberries

The seedling raspberries, mentioned in the Annual Report for 1948, have multiplied greatly, and growth of the canes is good. No fruit has been produced yet.

### Cape Gooseberry.

About one quarter of an acre of Cape Gooseberries were planted out on 25th May, 1949, at a spacing of 4 × 4 ft. The yield to date works out at only 900 lb. per acre. The yield would have been higher, had there been more rain towards the end of the year; as it was, the later part of the crop dried up. The plot will bear a second crop in 1950. Unless this yield can be improved upon, Cape Gooseberries will not be worth while as a canning crop except possibly for African growers. The Cape Gooseberries in this experiment were interplanted with Early Jersey Wakefield Cabbage; the value of this crop should therefore be taken into account when assessing the return from the Cape Gooseberries:—

|                                                                       | Sh. | cts. |
|-----------------------------------------------------------------------|-----|------|
| Cape Gooseberries, yielded 900 lb. per acre at 10 cts. per lb.        | 90  | 00   |
| Cabbage, interplanted, yielded 4,122 lb. per acre at 10 cents per lb. | 412 | 20   |
| Total ..                                                              | 502 | 20   |

### *Solanum muricatum*

This plant was mentioned in the Annual Report for 1948, under the name of Melon Berry, it has since been identified by Kew as *Solanum muricatum*, common name, Pepino. It is of South American origin and not Abyssinian, as previously stated.

### Vegetables

A number of vegetable trials were carried out with seed imported from Holland, details of these trials are as follows:—

**Bush Beans** (Bunchpodded) Fiyne Trosyes 3/DR.—Sown 6th June, 1949. Size of plot 8 × 32 ft.

The plants developed rust before the pods set. The pods were very small and of poor quality. The crop was pulled out and yield not recorded. Not recommended.

**Peas** (Round Seeded, Lente Droppers).—Sown 6th June, 1949. Size of plot 8 × 50 ft.

This pea produced very small pods and peas, and the quality was poor. The plants were badly attacked by mildew. Not recommended. The yield worked out at 3,839 lb. per acre, in the pod.

**French Beans** (Stamslabonen Dubbele Mit Draad).—Sown 6th June, 1949. Size of plot 8 × 78 ft.

The plants were badly attacked by rust. The pods were small yellow and curled, not stringless. The crop was pulled out and yield not recorded. Not recommended.

**Broad Beans** (ZW and De W. Verbeterde Hanger).—Sown 6th June, 1949. Size of plot 7 × 36 ft.

This is an excellent variety. The beans were tender and of good flavour. The yield worked out at 3,109 lb. per acre in the pod. Recommended.

**Chinese Cabbage** (Zelfsl Granaat).—Sown end of June.

The plants made excellent growth but were inclined to bolt. The crop would probably not have bolted if sown earlier in the season. Trial to be repeated next year with seed collected.

*Chicory* (Brussels Witlof Selectie).—Sown mid-June.

The plants made good growth and have produced large roots. An attempt will be made to force blanched shoots from the roots next season.

*Onion* (Queen, White Pickling).—Plot size 8 × 57 ft.

This variety did not bulb, and evidently requires a long day. Not recommended.

*Cauliflower* (Six Weeks).—Sown mid-June. Plot size 9 × 52 ft.

This is an early variety, small headed, firm, of good colour and texture. Samples sent to Kenya Orchards, Ltd., were favourably reported on for pickling. Messrs. Suttons state that Six Weeks is synonymous with Suttons Improved Snowball. The yield worked out at 5,208 lb. per acre. Highly recommended.

*Cauliflower* (Le Cerf).—Sown end of June. Plot size 9 × 52 ft.

An early variety, heads fairly large, but not of such high quality as Six Weeks. Texture inclined to be "ricey". The yield worked out at 5,766 lb. per acre. Recommended.

*Cauliflower* (Early Erfurt).—Sown end June. Plot size 9 × 52 ft.

Similar to Le Cerf, but yielded at the rate of only 2,237 lb. per acre. Not recommended.

*Cauliflower* (Alpha).—Curd formation was very poor. The trial was abandoned. Not recommended.

*Cabbage* (Early Jersey Wakefield, seed purchased locally).—Transplanted 31st May.

This is a very good early cabbage. The heads are small and pointed; very suitable for table use. This trial was interplanted in Cape Gooseberry; the spacing of the cabbage plants was 4 × 2 ft., the yield figure is therefore, correspondingly low. Yielded at the rate of 4,122 lb. per acre.

### Pests and Diseases

#### Pests.

The principal pest on fruit at Molo was Fruit Piercing Moth. There seems to be little information on this pest, and there is no satisfactory control. The moth attacked chiefly Apricot and Shiro plums, apples and peaches. Counts of damaged fruit revealed that 16 per cent of Apricot plums were attacked, whilst almost 100 per cent of peach fruits were damaged. Bait traps are being tried in the orchard, but it is expected that these will not give a satisfactory control. Damage has also been seen in private orchards on pears and citrus fruits. Last season a pear-grower lost a considerable sum of money owing to damage by Fruit Piercing Moth. The moth feeds at night, inserting its proboscis through the skin of the fruit and sucking the juice. The damage is first seen as a pinhole in the skin underlying which is a soft spongy area of tissue. After a few days the damaged area is invaded by a brown rot. The early damage is inconspicuous and is often unnoticed when the fruit is packed for market. The brown rot has usually developed by the time the fruit arrives at market which results in a correspondingly heavier loss to the grower. Research on the control of Fruit Piercing Moth is badly needed.

Other pests recorded at Molo were as follows:—

Red Spider on Cape Gooseberry.

Leaf Eating Moth Larvæ on apple, not yet identified.

Sucking Bug on apple, identified by Senior Entomologist as a Coreid bug a species of *Plectrocnemia*. This bug has been troublesome in the nursery; it inserts its proboscis at about 2 in. below the tip of a shoot and sucks the sap; death of the shoot follows, in a few days. As the bug is of large size it is possible to control it in the nursery by hand picking.

### Diseases

Strawberry Leaf Spot is troublesome on Royal Sovereign, but Melba is practically immune. Two American hybrid varieties, which have been grown from seed, have not developed the disease so far.

More queries are received about the control of Peach Leaf Curl, than about any other disease. This is understandable because an infected peach tree is an alarming sight early in the season. According to my observations this disease is not so serious as is often supposed. The first lot of leaves which open in the spring on an infected tree are often almost 100 per cent infected; these leaves mostly fall off after a short time and a second, and much larger crop of leaves is produced, which are mostly free from the disease; these leaves persist until the tree goes dormant. Enough infected material remains on the tree to carry on the disease until next season.

A spraying trial was carried out on infected trees at Molo this season. The treatments were as follows:—

1. "Capsine" (DNOC emulsion) at 5 per cent dilution, sprayed 24.8.49.
2. "Ovicide" (tar oil) at 5 per cent dilution, sprayed 16.8.49.
3. "Perenox" at 5 lb. per 100 gallons dilution, sprayed 31.8.49.
4. "Bordeaux" mixture at 1 per cent strength, sprayed 31.8.49.
5. Control.

The results of this trial indicate that the oil sprays, treatments 1 and 2, give a fair control of the primary infection (first leaf crop) in the early stages, but as the leaves grow, infection increases, and better control is effected by the copper fungicides, treatments 3 and 4. When the second crop of leaves had opened there was slightly more Leaf Curl on the Control trees than on any of the sprayed trees. In this experiment the difference between extent of infection, in the second crop of leaves, on sprayed and Control trees did not appear to warrant the cost of spraying. Harvesting of the crop is not yet complete, but yield records to date indicate no difference in crop between sprayed and unsprayed trees.

Observations in private orchards in all parts of the country indicate that the virus diseases, "Apple Mosaic" and "Infectious Plum Chlorosis", are widespread, but the total number of infected trees is not large.

Propagation of nursery stock is the only source of infection, so far as is known. Quarantine regulations are in force for these diseases.

### Meteorological Figures for 1949

|          | Jan.  | Feb.  | Mar.  | Apr.  | May   | June  | July  | Aug.  | Sep.  | Oct.  | Nov.  | Dec.  | Total Rainfall |
|----------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|----------------|
| Max. . . | 72.2° | 72.9° | 75.1° | 72.7° | 69.6° | 66.0° | 65.5° | 65.5° | 67.0° | 70.7° | 70.2° | 70.0° |                |
| Min. . . | 41.1° | 40.9° | 41.9° | 46.6° | 45.1° | 43.8° | 44.0° | 43.5° | 43.6° | 42.3° | 43.0° | 47.3° |                |
| Mean. .  | 56.7° | 56.9° | 58.5° | 59.6° | 57.4° | 54.9° | 54.8° | 54.5° | 55.3° | 56.5° | 56.6° | 58.7° |                |
| Rainfall | 0.13" | 0.74" | 0.13" | 9.19" | 4.45" | 4.63" | 4.83" | 7.75" | 5.44" | 0.85" | 1.55" | 2.31" | 42.00"         |

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## ANNUAL REPORT OF THE SENIOR AGRICULTURAL OFFICER (PYRETHRUM), 1949

### Experimental Stations

*Ol Joro Orok* (7,800 ft.).—The long rains arrived late and although there were a few light falls in April, the main rains did not break until the last week in May. Picking started in mid-July, but the season was a short one and yields rather poor.

The planting of new crop took place in June. Old pyrethrum plots were planted with grass to rest the soil.

*Molo* (8,300 ft.).—The rains commenced in April and some planting was done in that month. This was followed by a dry spell in the first half of May so that the later plantings had to be held over until the second half of the month. The season was rather short although the total rainfall for the year was about average. Owing to the comparatively short picking season, yields were disappointing.

The water supply for this station is still rather uncertain as the dam has not yet been completed.

*Subukia* (7,000 ft.).—The most important part of the work of this station is the testing out of new pyrethrum strains at a low altitude. In addition to the breeding plots a spacing trial was planted. Old pyrethrum land was planted with maize.

*Kitale* (6,300 ft.).—Owing to its isolated position and the difficulty of maintaining adequate supervision, it was decided to give up this station. The breeding work which was carried on at this station has now been transferred to the Scott Agricultural Laboratories (5,800 ft.).

### Plant Breeding

The breeding of a new strain of pyrethrum is a slow business and may take six to nine years before the grower receives any seed. Before the industry can feel any material benefit, a further period of some years is required whilst the grower is replacing his old crop with the new variety.

The breeding programme at present in use may be summarized briefly as follows:—

*First Stage* (1-3 years).—The collection and testing of single plant selections. These are selected from pyrethrum fields, split and planted in rows. Observations are kept on yield, average flower weight, pyrethrin content, resistance to bud disease and habit of growth.

*Second Stage* (1-2 years).—The crossing of desirable selections in isolated plots (to avoid contamination from foreign pollen) and the growing of the seedlings from these crosses.

*Third Stage* (1-2 years).—Testing the seedlings from the various crosses in yield trials at various altitudes. Observations as in first stage.

*Fourth Stage* (1 year).—Having found the most suitable crosses, it is necessary to bulk the original parent plants by vegetative means.

*Fifth Stage* (2 years).—This is a repetition of the second stage but on a large scale. The planting material produced in the fourth stage is established in isolated seed production field. Seed from this field is issued to growers. There may be a small picking in the first year but the main production would be in the second and following years.

The present breeding programme was started in 1946 and during the past year, work on the fourth stage, (vegetative propagation) has been in progress. In order to save time, the bulking of three parent clones was started before the trials of their progeny had been completed and during 1949 the third and fourth stages were proceeding concurrently.

*New Strains*

Three clones (188, 194 and 214) were bulked vegetatively in order to produce seed from one or both of the following crosses:—

188 × 194

188 × 214

At the same time, tests were proceeding on seedlings from these crosses. These have shown that whilst there is little to choose between them as regards yield of flowers, 188 × 214 is definitely superior as regards pyrethrin content:—

## ANALYSES ON A.O.A.C. BASIS

## (Percentage total pyrethrins)

| <i>Subukia</i> (7,000 ft.)— |    |    |    | 188 × 194 | 188 × 214 |
|-----------------------------|----|----|----|-----------|-----------|
| 17th August, 1949           | .. | .. | .. | 2.65      | 3.00      |
| 16th September, 1949        | .. | .. | .. | 2.48      | 2.68      |
| 24th October, 1949          | .. | .. | .. | 2.26      | 2.51      |
| 20th December, 1949         | .. | .. | .. | 2.08      | 2.28      |
| Average                     |    |    |    | 2.37      | 2.62      |
| <i>Molo</i> (8,300 ft.)—    |    |    |    |           |           |
| 5th February, 1949          | .. | .. | .. | 3.14      | 3.00      |
| 4th March, 1949             | .. | .. | .. | 2.46      | 2.62      |
| 4th August, 1949            | .. | .. | .. | 2.09      | 2.76      |
| 17th August, 1949           | .. | .. | .. | 2.44      | 3.00      |
| 24th October, 1949          | .. | .. | .. | 2.60      | 3.00      |
| 16th January, 1950          | .. | .. | .. | 2.34      | 2.68      |
| 27th January, 1950          | .. | .. | .. | 2.11      | 2.22      |
| Average                     |    |    |    | 2.45      | 2.75      |

Most of these analyses were carried out spectrophotometrically and separate figures for pyrethrins I and II were not available. This is an important point since pyrethrin I is regarded as being more toxic than pyrethrin II. The result of a full analysis is given below. In this test 188 × 214 proved superior not only as regards total pyrethrins but as regards pyrethrin I also:—

|                   | Pyrethrin I<br>per cent | Pyrethrin II<br>per cent | Total<br>per cent |
|-------------------|-------------------------|--------------------------|-------------------|
| 188 × 194 .. .. . | 1.14                    | 0.97                     | 2.11              |
| 188 × 214 .. .. . | 1.23                    | 0.99                     | 2.22              |

The 1949 results suggest that both these strains are primarily low altitude ones. At Subukia, they yielded more than 840 lb./acre where the yield from ordinary pyrethrum amounted to 500 lb./acre. At Molo, on the other hand, where conditions are usually more favourable, they averaged only 750 lb./acre. Although the high pyrethrin content at Molo would more than offset the somewhat reduced yield, it is thought that these strains would be of greater benefit to the low altitude grower. Judging from the results already obtained, the increased yield and content at the lower altitudes might result in the output of pyrethrins per acre being at least doubled. The lowest altitude at which these strains can be grown economically is not yet known but it would appear that by the use of low altitude strains, the pyrethrum growing areas of Kenya might be materially increased.

Owing to the increased content of 188 × 214, it is proposed to issue seed of this strain in preference to 188 × 194.

During the 1948-49 season, some ordinary commercial seed used as a control in a variety trial, produced the astonishing yield of 1,970 lb./acre at Molo. Other varieties in the trial averaged only 892 lb./acre.

Three analyses (A.O.A.C. Basis) gave fairly good results:—

|                    |    |    |    |    |               |
|--------------------|----|----|----|----|---------------|
| 30th January, 1948 | .. | .. | .. | .. | 1.66 per cent |
| 16th March, 1948   | .. | .. | .. | .. | 1.35 per cent |
| 23rd August, 1948  | .. | .. | .. | .. | 2.00 per cent |

Field observation and an examination of yield data showed that although one would have expected a fairly large degree of variation between individuals drawn from an ordinary commercial strain, yet the performance of these plants had been remarkably uniform, suggesting that by some fortunate chance most of the original seed had a common parentage.

In 1949, the plants were rogued and the remainder, numbering 200 plants, were split and planted in an isolated plot. It is intended to use these plants partly for future breeding work and partly for the immediate production of seed. Small issues of seed would be made to high altitude growers for further trial. This strain has been named "1970 Control".

In addition to 188 × 214 and 1970 Control, which are in the later stages of production, there is breeding material in the earlier stages also. During 1949, there were 170 selections undergoing test, 12 isolated plots being utilized for crossing and 35 crosses undergoing tests in yield trials.

Surplus seedlings from 22 crosses were planted out in bulk plots to serve as a source of material for future selection work.

#### *Powell Crosses*

Several crosses have been made between high content clones and a very vigorous, upright, large flowered but low content strain, bred by Mr. G. S. Powell at Elburgon. The seedlings from these crosses were significantly better yielders and their flower weights were significantly greater. They also tended to inherit the upright flowering habit of the Powell parent. But the average pyrethrin content of the Powell Crosses was somewhat lower than is normally obtained in crosses between two high content parents. However, it should be possible to find individuals within these crosses, combining the good qualities of both parents. With this end in view, a number of selections were made from the Powell Crosses.

#### *Exchange of Seed*

A scheme was started whereby small quantities of seed were exchanged with other pyrethrum growing countries. During 1949, seed was exchanged with the Belgian Congo, Kashmir and Japan. The imported seed was planted out and the resulting seedlings will be grown in bulk plots for observation and possibly for use in future breeding work. Planting material from four clones was sent to southern Tanganyika for trial.

#### *Incompatibility*

In the course of the past few years, about 60 crosses have been made. Some crosses are remarkably prolific and the seed germinates well. Other crosses, apparently made under the same conditions, produce very little viable seed.

The two best clones available at present, 194 and 214, do not cross well together and this cross has had to be abandoned in favour of 188 × 214, a cross which produces abundant good seed.

There is also evidence that in some crosses fertile seed may be obtained from one parent but not from the other.



As crosses are normally made in the open, in isolated plots, insect pollination is uncontrolled and it is possible that the failure of certain crosses may have been due to some extraneous cause, unrelated to any inherent incompatibility between the parents. General experience suggests, however, that this is unlikely and it is hoped that an opportunity will be found to study this question further, under more carefully controlled conditions.

### *Vegetative Propagation*

In last year's report, it was stated that a technique was being developed for the rapid propagation of pyrethrum by cuttings. Trials on an experimental scale had given encouraging results and this year, the method was put into practice on a larger scale for the bulking of the parent clones, 188, 194 and 214. The work was slow in the early stages. This was partly due to the fact that the rains were late and it was not possible to start the work until the parent plants had ended their dormant season. It was also due to lack of experience, the losses of cuttings in the early stages being greater than had been anticipated on a basis of previous trials. Later, the method of propagation was modified and losses were cut down very considerably.

One of the difficulties is to get the cuttings to develop rooted branches rather than to grow long, spindly flowering stems. A trial carried out last year showed that rooting could be induced by layering. It has since been found more satisfactory to earth up the beds by applying compost or rich forest soil. This encourages branching and rooting around the crown of the plant.

By the end of the year, there were 16,000 rooted cuttings of the three clones, established at Molo and Ol Joro Orok and it was estimated that the population could be doubled every three months, provided that the water supply at Molo remained adequate during the 1950 dry season.

### **Bud Disease**

#### *Co-operative Experiment*

It was known that the incidence of bud disease was considerably influenced by the inherent resistance of the plant, but little was known about the influence of environment. In order to study environmental effects, growers were asked if they would accept 20 plants of a standard clone and keep weekly counts of the numbers of flowers and diseased buds picked. Thirty-nine growers in Kenya and one in Tanganyika agreed to carry out the work and splits of the standard clone were distributed in May and June.

Results were not very complete this season as the plants suffered, in many cases, from drying out in transit or from poor planting conditions on arrival. Nevertheless, it was possible to reach some general conclusions. The counts on farms east of the Rift Valley averaged far less disease than those west of the Rift Valley. The reason for this is not known, but it tends to support observations made in previous years that some districts east of the Rift Valley, such as Nanyuki, have never suffered serious loss, although the *Ramularia* fungus is known to be present. The main incidence of disease occurred in both areas in July—September; after that losses were much smaller.

|                     | No. of<br>Counts |     |    |    | Average No. of<br>diseased buds<br>per 100 flowers |
|---------------------|------------------|-----|----|----|----------------------------------------------------|
| East of Rift Valley | 16               | ..  | .. | .. | 4.6                                                |
| West of Rift Valley | 9                | ... | .. | .. | 11.4                                               |

It is hoped that it will be possible to continue this trial in order to learn whether the difference in infection between the eastern and western areas is repeated or whether it was a peculiarity of the 1949 season. It is also hoped that the number of counts will be increased in order that the subject may be studied

in greater detail. In the meantime, it would appear that different environmental influences, acting on a single clone, may modify the incidence of the disease quite considerably. It is interesting to note, for example, that the Nanyuki district maintained its reputation for comparative freedom from attack. Only three diseased buds were recorded in the course of picking 1,446 flowers in this area—a bud disease rate of 0.2 per cent. During the same period—from the end of August to mid-January—the western area had an average disease rate of 9.9 per cent.

### *Pruning Trial*

A pruning trial was carried out at Ol Joro Orok in order to test the effect of bud losses on yield. Two lots of ten plants, from a single clone were taken. The control plants lost an average of 6.9 buds per 100 flowers through bud disease. The pruned plants lost buds at about the same rate through disease but the losses were increased by pruning to represent a disease rate of 25 per cent. Picking was carried out once a week and the pruning was done at each picking on a basis of the number of flowers picked from each plant. The buds were picked at random, leaving the stems.

This rather drastic pruning actually appeared to stimulate flower production in the early part of the season and the pruned plants gave slightly more flowers than the unpruned until near the end of October. In the dry, end of season weather, however, the pruned plants were unable to make good all their losses and the control was a little in advance of the pruned treatment at the end of the year.

|         |    |    |    | No. of<br>Buds Lost | Buds lost<br>per 100 flowers | No. of<br>Flowers Picked |
|---------|----|----|----|---------------------|------------------------------|--------------------------|
| Pruned  | .. | .. | .. | 630                 | 25.5                         | 2,469                    |
| Control | .. | .. | .. | 178                 | 6.9                          | 2,578                    |

Although the pruned plants lost 452 more buds than the control, yet their flower production was only 109 flowers short of the control's total. The pyrethrum plant has a certain recuperative power. If a bud is lost, it endeavours to replace it. This process appears to be comparatively easy during the rains, but more difficult during the dry weather, when water supplies are running short.

The average loss from bud disease, according to the counts carried out by growers in 1949, was 8.7 buds per 100 flowers. The results of this pruning trial suggest that losses might have been three times as heavy without causing much loss of flowers.

### *Bud Disease and Yield*

Further evidence in support of the view that bud disease has comparatively little effect on yield, was obtained from a study of plant selection records at Molo and Ol Joro Orok for 1948/49. These revealed that over the season as a whole there was no significant correlation between bud disease rates and yield. An extreme example of the sort of thing that occurred was furnished by one selection which sustained an average loss of 40.2 diseased buds per 100 flowers and yielded 1,508 gm. The selections as a whole suffered an average loss of 6.4 buds per 100 flowers, yet their mean yield was only 1,294 gm., considerably less than the heavily attacked selection.

Although there was no significant correlation between bud disease rates and yield over the season as a whole, yet the same plants did show significant correlations during the three-month flush period, July—October.

|                       | Bud Disease Rate | Correlation Coefficient | Significance    |
|-----------------------|------------------|-------------------------|-----------------|
| <i>Ol Joro Orok</i> — | <i>Per cent</i>  |                         |                 |
| Flush Period .. ..    | 6.9              | — .3000                 | Significant     |
| Whole Season .. ..    | 6.8              | — .0442                 | Not Significant |
| <i>Molo</i> —         |                  |                         |                 |
| Flush Period .. ..    | 2.8              | — .2995                 | Significant     |
| Whole Season .. ..    | 6.4              | — .2238                 | Not Significant |

At both stations, the bud disease rate was associated with reduced yield to a far greater extent during the flush period than over the season as a whole. This effect appears to be quite independent of the extent of infection. Thus, at Molo, the degree of correlation was greater when the average infection was only 2.8 per cent than when the infection rate was 6.4 per cent—more than twice as great.

No attempt is made here to explain these curious results, but it is apparent that the relationship between bud disease and yield is not a straightforward one and it is thought that the incidence of disease is influenced by the general physiological condition of the plant. A further series of correlation studies has been carried out. This provides evidence of the strain thrown on a plant by the intense flowering activity of the flush period. Results, however, are not yet complete.

#### *Bud Disease and Pyrethrin Content*

The effect of bud disease on pyrethrin content appears to be much more drastic than its effect on yield. When the fungus attacks a young bud, it will die before reaching maturity and no flower will be picked. If the bud is almost mature at the time of attack, it will have time to open and produce a flower before the fungus cuts off the food supply from the stem and arrests further development. Such a flower will show a brown discoloration on its lower side instead of the normal green colour. An experiment was carried out in which healthy and diseased flowers were picked from the same plants and analysed for pyrethrin content. The result showed that the disease had had a very marked effect on the pyrethrins:—

|                        | Pyrethrins % |
|------------------------|--------------|
| Healthy Flowers .. ..  | 1.63         |
| Diseased Flowers .. .. | 1.02         |

If all the flowers in a field were attacked, one might expect the pyrethrin content to drop by more than a third. This is unlikely to happen in practice, but even if one flower in three is affected, it is likely that the average content would drop from, say, 1.60 per cent to 1.40 per cent. Fortunately, severe attacks do not usually last more than a few weeks; nevertheless a drop of .20 per cent in content during a flush period means quite a severe loss.

It is thought, however, that the loss in content would only occur when the flowers themselves show signs of attack. If most of the attacked buds are killed off before maturing, the content of the flowers may not be affected appreciably. One case was observed where the flowers from a selection had a good content (2.10 per cent) at a time when the bud disease rate was 41 per cent.

*Spraying Trial.*—Spraying with the inorganic sprays, Bordeaux and Lime Sulphur, was tried in 1946 without success. This year, a second trial was undertaken using the organic sprays, Shirlan, Tulisan and Spersul as well as Perenox. As in 1946, spraying had no effect on bud disease.

*Weeding Trial.*—A small trial was planted in order to test the effect, if any, of weeds on bud disease. So far, no connexion has been traced.



*Time of Cutting Back Trial.*—This trial was started in 1947 in order to see whether it might be possible, by selecting a suitable time for cutting back, to have the main flush at a period which would be favourable as regards bud disease. The trial consists of twelve cutting back treatments—one for each month of the year—and a control which is not cut back at all. Bud counts are kept on all treatments.

The results over the past three seasons show that provided cutting back is carried out some time between the beginning of February and the end of June, time of cutting back has no appreciable effect on bud disease. Cutting back between 1st July and 1st February was associated with somewhat higher disease rates. The uncut, control treatment had a comparatively high disease rate and it would appear that failure to cut back encourages the disease.

### General Experimental Work

#### *Rotation Trials*

Work continued on the two rotation trials at Ol Joro Orok. It was decided that the smaller trial, planted in 1946 should be brought to a close. In 1950, all the plots will be planted with wheat, in order to test the effect of wheat following pyrethrum as compared with wheat following grass and wheat following wheat.

Planting of the larger trial is carried out over a period of three seasons. The final third of the planting was completed this year. This trial is designed to test the following rotations with varying quantities of fertilizer:—

- Continuous Pyrethrum.
- Pyrethrum: Cereals.
- Pyrethrum: Grass: Grass.
- Pyrethrum: Grass.
- Pyrethrum: Pyrethrum: Grass.
- Pyrethrum: Cereals: Grass.

Each crop remains on the ground for a period of three years.

A small trial at Molo, designed to test the effect of green manures on pyrethrum, was continued.

#### *Altitude and Pyrethrin Content*

It had long been suspected that pyrethrin content was affected by the altitude at which the crop was grown. It will be noted, for example, that the pyrethrin contents of the new strains (given earlier in this report) were substantially greater at the high altitude station, Molo, than at Subukia, 1,300 ft. lower. Such evidence is not conclusive, however, since the differences might also have been due to some special peculiarity of the soil and climate not normally associated with a change in altitude.

More convincing evidence was obtained by an examination of the data accumulated during the first twelve months' operation of the grading by analysis system of marketing flowers. For this work, pyrethrum areas of Kenya are divided into 19 zones and the production of flowers and pyrethrins is recorded on a zonal basis. The average pyrethrin content for each of the zones during the period September, 1948-49, was compared with the mean altitude of the pyrethrum-growing farms in each zone.

Despite the fact that there were sometimes very wide differences in altitude between the highest and lowest farm in a zone, a factor which would be expected to decrease the accuracy of the data considerably, a very significant correlation was found between altitude and pyrethrin content ( $P < .001$ ). The regression of pyrethrin content on altitude showed a mean increase of .08 per cent pyrethrins per 1,000 ft. increase in altitude.

### *Germination of Pyrethrum Seed*

A previous trial had shown that pyrethrum seed germinated better at a comparatively low temperature. A second trial was carried out this year at the Scott Agricultural Laboratory Seed Testing Station. This was designed to test the effect of varying periods of pre-germination chilling as well as the temperature of germination. Chilling periods of two, four, six and eight weeks were tested in conjunction with two temperatures of germination in a trial having 16 treatment combinations of 400 seeds each.

The results showed that pre-germination chilling had reduced the germination percentage significantly. A low temperature of germination, however, had significantly improved germination, thereby confirming the results of the previous trial.

#### *Germination Percentages*

|                       |    | <i>Chilled</i> | <i>Not Chilled</i> | <i>Mean</i> |
|-----------------------|----|----------------|--------------------|-------------|
| Germinated at 68° F.  | .. | 19.0           | 23.1               | 21.0        |
| Germination at 51° F. | .. | 22.6           | 28.6               | 25.6        |
|                       |    | <hr/>          | <hr/>              | <hr/>       |
| Mean                  | .. | 20.8           | 25.8               | 23.3        |
|                       |    | <hr/>          | <hr/>              | <hr/>       |

A preliminary trial was started in order to see what differences may be expected with harvesting at different times of the year. The results were somewhat startling. Seed collected from the same plants varied between a germination of 22 per cent in March and 58 per cent in December. It would appear that natural factors, such as climate or the prevalence of insect pollinators, may exert a considerable influence on the viability of seed under local conditions.

### *Use of Oil Burners in Pyrethrum Driers*

The use of oil fuel instead of firewood in pyrethrum driers was suggested some time ago. Tests were carried out this year at Ol Joro Orok using a flame gun. It was found that although the oil was burned with about twice the efficiency of firewood, yet its use was very much more expensive. In this trial, it was estimated that the cost of oil fuel required to do the same amount of work as a ton of wood, would be over £4.

Subsequent discussions with a representative of an oil company suggested that whilst the cost of the oil fuel might have been further reduced without the use of elaborate equipment, oil burners in pyrethrum driers of the present design were always likely to be prohibitively expensive in comparison with wood fuel. The cost of oil fuel might be further reduced, however, if a satisfactory drier were designed to enable the furnace gases to pass directly through the trays of flowers.

### *Trace Elements*

Work elsewhere had suggested that manganese and/or magnesium might improve the pyrethrin content of flowers. Two small trials, carried out at Ol Joro Orok, did not give encouraging results.

In the first trial, a .025 per cent solution of manganese sulphate was introduced into the flower stems by means of paper wicks, distilled water being used as a control treatment. The treated flowers showed an increased manganese content but the pyrethrin content was only 2.56 per cent as compared with 3.00 per cent for the control.

In the second trial a solution of magnesium sulphate was applied at a rate of 30 lb. magnesium oxide per acre, the control being given an equal volume of plain water. There were four replications of treatment and control. A picking of flowers 14 days later showed that whilst the magnesium treatment had increased the magnesium content by 22 per cent, it had had no effect on pyrethrin content.

### *Pyrethrin Stabilizers*

Eight trials of three substances supplied by the Scientific Adviser to the Pyrethrum Board were carried out for him and samples sent for analysis.

### **Advisory**

#### *Farmers' Days*

A farmers' day attended by about 50 growers was held at Molo in October. Visitors were shown the work which is being carried out on fruit by the Agricultural Officer (Horticulture) as well as the pyrethrum work.

About 170 visitors attended a farmers' day held at the Government Experimental Farm, Ol Joro Orok at the end of October. In addition to the pyrethrum work, visitors were shown round the farm as a whole, inspecting all the main aspects of the work which is being carried out there.

Through the kindness of Major L. B. L. Hughes, a pyrethrum day was held on his farm on the South Kinangop. In spite of rather uncertain weather, there were about 50 visitors. Part of the day was devoted to talks and discussions, the remainder being occupied with an interesting tour of Major Hughes' farm.

Four meetings of growers were attended and short talks given on various aspects of pyrethrum growing.

#### *Nakuru Agricultural Show*

An exhibit was staged on the Pyrethrum Board's stand at the 3-day agricultural show held at Nakuru in September/October.

#### *Visits to Farms*

Sixty-five farms were visited during the year by the Senior Agricultural Officer and the Assistant Agricultural Officer. Several of these visits were made in connexion with falls in pyrethrin content; others were concerned with the co-operative bud disease experiment.

A case of root rot was investigated at Ol Joro Orok. The Senior Plant Pathologist identified the causative organism as *Sclerotinia* sp. Usually root rot is associated with old *manyatta* land, but in this case, the field had not been a *manyatta* site and had previously grown pyrethrum without any sign of attack.

A case of suspected root rot at Gilgil was thought later to have been due to some adverse condition of the soil.

On a farm in the Ol Joro Orok district, a proportion of the flowers over a period of a few weeks failed to develop properly. The condition was characterized by circular depressions in the flower discs. The Senior Plant Pathologist was of the opinion that this malformation was due to an infection of the stem by bud disease.

A reported case of damage by beetles on the Kinangop turned out to be without foundation. The beetles (members of the *Nitidulidae*) were harmless pollen feeders.

#### *Pyrethrum Growing in North Nyeri District*

An area in which it is proposed to plant about 50 acres of pyrethrum in North Nyeri native reserve was visited and advice given. Small plots will be taken over by individual Africans who will send their flowers to a central drier run on co-operative lines. An African instructor was given three months training in pyrethrum and later assistance was given in the purchase of planting material.

#### *Publications*

The following articles were published during the year:—

Vegetative Propagation of Pyrethrum.

Aids to Pyrethrum Growing.

The Use of Pyrethrum as a Rotation Crop.

The Use of Oil Burners in Pyrethrum Driers.



Aids to Pyrethrum Growing was a booklet consisting of seven articles by the Senior Agricultural Officer and one article by a sub-committee of P.A.R.A.C.

### *Conclusion*

The recent increases in price have stimulated renewed interest in the crop and the advisory work has been much more considerable than in previous years.

### **Acknowledgments**

Acknowledgments are gratefully made to Mr. V. A. Beckley, scientific adviser to the Pyrethrum Board for the numerous analyses which he has carried out during the year, to members of P.A.R.A.C. for their advice and assistance and to Mr. N. H. Hardy, executive officer of the Pyrethrum Board and his staff for help on many occasions.

Finally, the ready assistance and co-operation of the staff of this section must be recorded and gratefully acknowledged.

E. W. GADDUM,  
*Senior Agricultural Officer (Pyrethrum).*

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APPENDIX  
Meteorological Records  
MOLO

| Month             | Rain       | Humidity<br>per cent<br>8.30 a.m. | Max. Mean<br>°F. | Min. Mean<br>°F. |
|-------------------|------------|-----------------------------------|------------------|------------------|
|                   | <i>In.</i> |                                   |                  |                  |
| January .. .. .   | 0·13       | 79                                | 72·4             | 41·1             |
| February .. .. .  | 0·74       | 70                                | 72·9             | 40·9             |
| March .. .. .     | 0·13       | 65                                | 75·1             | 41·9             |
| April .. .. .     | 9·19       | 75                                | 72·5             | 46·6             |
| May .. .. .       | 4·45       | 79                                | 69·4             | 45·0             |
| June .. .. .      | 4·63       | 80                                | 66·0             | 43·8             |
| July .. .. .      | 4·83       | 85                                | 65·0             | 44·0             |
| August .. .. .    | 7·75       | 81                                | 65·5             | 43·5             |
| September .. .. . | 5·44       | 78                                | 67·1             | 43·6             |
| October .. .. .   | 0·85       | 67                                | 70·4             | 42·3             |
| November .. .. .  | 1·55       | 75                                | 70·3             | 41·6             |
| December .. .. .  | 2·31       | 84                                | 72·3             | 47·0             |
|                   | 42·00      | 76                                | 69·9             | 43·4             |

OL JORO OROK

| Month             | Rain       | Humidity<br>per cent<br>8.30 a.m. | Max. Mean<br>°F. | Min. Mean<br>°F. |
|-------------------|------------|-----------------------------------|------------------|------------------|
|                   | <i>In.</i> |                                   |                  |                  |
| January .. .. .   | 0·00       | 66                                | 73·8             | 39·2             |
| February .. .. .  | 0·83       | 64                                | 74·1             | 39·1             |
| March .. .. .     | 0·12       | 61                                | 76·1             | 41·9             |
| April .. .. .     | 1·78       | 72                                | 75·0             | 45·9             |
| May .. .. .       | 3·82       | 76                                | 72·5             | 44·2             |
| June .. .. .      | 4·05       | 82                                | 68·1             | 44·1             |
| July .. .. .      | 4·00       | 86                                | 66·8             | 44·9             |
| August .. .. .    | 10·39      | 85                                | 67·3             | 41·9             |
| September .. .. . | 6·57       | 86                                | 68·9             | 43·7             |
| October .. .. .   | 1·58       | 66                                | 73·5             | 42·4             |
| November .. .. .  | 0·35       | 82                                | 70·8             | 43·3             |
| December .. .. .  | 2·35       | 79                                | 69·7             | 47·7             |
|                   | 35·84      | 75                                | 71·4             | 43·2             |

SUBUKIA

| Month             | Rain       | Humidity<br>per cent<br>8.30 a.m. | Max. Mean<br>°F. | Min. Mean<br>°F. |
|-------------------|------------|-----------------------------------|------------------|------------------|
|                   | <i>In.</i> |                                   |                  |                  |
| January .. .. .   | 0·00       | 59                                | 76·7             | 46·9             |
| February .. .. .  | 0·37       | 56                                | 77·3             | 48·9             |
| March .. .. .     | 0·09       | 55                                | 80·4             | 49·7             |
| April .. .. .     | 6·80       | 68                                | 77·0             | 50·8             |
| May .. .. .       | 4·04       | 73                                | 74·1             | 49·4             |
| June .. .. .      | 5·95       | 74                                | 71·5             | 49·1             |
| July .. .. .      | 6·82       | 79                                | 70·9             | 49·2             |
| August .. .. .    | 8·66       | 78                                | 70·7             | 47·5             |
| September .. .. . | 6·43       | 72                                | 71·8             | 48·0             |
| October .. .. .   | 1·53       | 59                                | 74·5             | 45·9             |
| November .. .. .  | 0·70       | 64                                | 74·3             | 47·9             |
| December .. .. .  | 2·00       | 65                                | 73·8             | 50·4             |
|                   | 43·39      | 67                                | 74·4             | 48·6             |

# ANNUAL REPORT OF THE AGRICULTURAL OFFICER IN CHARGE, HIGH LEVEL SISAL RESEARCH STATION, THIKA, 1949

## Advisory Work

Thirty-four visitors attended a successful Field Day at the station on the 7th April as guests of the Kenya Sisal Growers' Association. Visitors were shown round the experiments and a comprehensive display of diagrams and exhibits illustrating the experimental work was prepared.

There was a considerable increase in the number of visitors to the station, especially from overseas. Visits were made by members of the staff to sisal estates and every opportunity of discussing problems with farmers was taken.

Quarterly notes on work at the station and a memorandum with "Suggestions for improving the efficiency of Sisal Growing in Kenya" were circulated to all sisal growers during the year.

## High Level Sisal Research Station, Thika

### *Meteorological*

Both the long and the short rains were late in starting and the total rainfall for 1949 is the lowest since recording started at the station in 1941.

The rainfall for the year was: January 0.15 in. in one day; February nil; March nil; April 8.09 in. in 14 days; May 1.97 in. in 3 days; June 0.9 in. in 3 days; July nil; August 0.59 in. in 4 days; September 0.20 in. in one day; October 0.15 in. in 3 days; November 1.88 in. in 6 days; December 5.48 in. in 14 days; total 19.41 in. in 49 days

The average rainfall for the nine years 1941-49 is 32.0 in.

### *Land Preparation*

Approximately 4 acres of old sisal land and 20 acres of virgin land were cleared, ploughed and harrowed. There was little development of dormant "couch" during the long dry season hence planting was postponed until the area could be thoroughly cleaned.

### *Sisal Production*

The production of sisal during 1949 amounted to 7 $\frac{1}{4}$  tons line fibre, 1.13 tons tow and 1.39 tons flume tow, a total of 9.77 tons which was sold locally to Sisal Products (E.A.) Ltd., Ruiru.

### *Buildings*

The house for the third officer was completed in April, when work started on permanent quarters for the field assistants on the external trials. With the exception of the roof of one building, these are all finished and thanks are due to owners and managers on the estates for their help.

In conjunction with the rebuilding of the 10,000-gallon water reservoir a water filtration plant was built ensuring clean water for research work and domestic uses.

### *Fruit and Forest Trees*

Budding of citrus was carried out on a small scale as a sideline with the object of meeting a long-felt need by sisal farmers. About 400 plants were budded with Washington Navel budwood which was kindly supplied by Mr. G. W. Carver of Juja Farm. It is hoped that about 400 plants will be available for distribution during 1950.



The production of tree seedlings for planting at the station on non-arable land and for distribution to sisal growers was undertaken as an additional service to growers. This work is done during slack periods by trained labourers and it does not interfere in any way with the experimental work of the station.

Five thousand cypress trees were distributed.

It is felt that every encouragement should be given to tree planting on sisal estates where tree planting has not been extensive in the past. It is probable that the smashing of sisal boles for mulching fields will become a general practice in the future and in this event the lack of firewood for large labour forces will become a serious problem.

### Investigational Work in Progress—High Level Sisal Research Station, Thika

#### Cutting Trial

This trial was planted in March 1941 with a spacing of 12 ft. by 3 ft. (1,210 plants per acre). First cuts were made at  $3\frac{1}{2}$ , 4 and  $4\frac{1}{2}$  years with intervals between cuts of 6, 12 and 18 months. Intensities of cuts are "Heavy", leaving 12 leaves, and "Light", leaving 36 leaves. The trial was cut to programme in February and August and the numbers of cuts vary from five to 11. The total yield figures from the various treatments may not vary greatly when all plots get to 100 per cent poling, but if the yield is based on the average yield per acre per year of the cycle the treatments taking a longer time will give a substantially lower yield per acre per annum. All the treatments cut lightly reached a yield figure of over 5.50 tons per acre between 7 and  $7\frac{1}{2}$  years with poling varying from 64 per cent to 98 per cent, while the heavy cuts took from  $7\frac{1}{2}$  to  $8\frac{1}{2}$  years to reach this figure, with poling varying between 4.17 and 100 per cent. Nothing has occurred this year which would tend to alter the indications given in last year's report.

#### Spacing Trial

This trial was planted during February 1941. All plots have been cut light and the first cut in all plots was made  $3\frac{1}{2}$  years after planting. The interval between cuts is one year. The 15 ft. by 4 ft. (726 plants per acre) poled out 100 per cent after  $7\frac{1}{2}$  years and 11 ft. by 4 ft. (990) after 8 years. An indication of the development of the plants can best be gained from the following table:—

TABLE I

| Spacing                                                              | 15'x4' | 11'x4' | 18'x3 $\frac{1}{2}$ 'x4' | 12'x3' | 15'x2' | 22'x2'x2 $\frac{1}{4}$ ' | 11'x2 $\frac{1}{4}$ ' | 10'x2' |
|----------------------------------------------------------------------|--------|--------|--------------------------|--------|--------|--------------------------|-----------------------|--------|
| Population ..                                                        | 726    | 990    | 1,013                    | 1,210  | 1,452  | 1,613                    | 1,760                 | 2,178  |
| No. of leaves cut ..                                                 | 228.9  | 228.6  | 227.2                    | 228.8  | 210.3  | 185.2                    | 205.5                 | 194.5  |
| Wt. in lb. of leaves cut ..                                          | 398.2  | 367.5  | 374.4                    | 347.4  | 347.—  | 295.3                    | 332.5                 | 303.8  |
| Av. wt. per leaf cut, lb. ..                                         | 1.74   | 1.61   | 1.65                     | 1.64   | 1.65   | 1.59                     | 1.59                  | 1.56   |
| Lb. fibre per plant ..                                               | 13.09  | 12.68  | 12.61                    | 12.64  | 12.06  | 9.78                     | 11.25                 | 10.29  |
| Tons fibre per acre ..                                               | 4.24   | 5.60   | 5.70                     | 6.82   | 7.82   | 7.04                     | 8.83                  | 10.—   |
| Poling % ..                                                          | 100%   | 100%   | 97.9%                    | 96.9%  | 66.7%  | 36.5%                    | 67.7%                 | 47.9%  |
| Av. yield per acre/year since planting to 100% poling or to 9 years. | 0.56   | 0.70   | 0.63                     | 0.76   | 0.87   | 0.78                     | 0.98                  | 1.11   |

Except for 22' x 2' x 2 $\frac{1}{4}$ ' (1,613) where crowding in the double rows has not been compensated for by the wide spacing between the double rows, the trend is clearly in the direction of increased yield with increased population per

acre, in spite of the individual plant performance being lower. It would be wrong to anticipate the performance of individual plants at 100 per cent poling for all plots, but most plots have probably reached the stage where farmers would cut them out and replant. The above table shows that there is no reason to expect short and light leaves when high populations are used under the conditions obtaining at the Station. This trial is now nearly nine years old and the yield figures indicate clearly that 0.70 tons per acre per year of the cycle is a practicable possibility. It does of course involve field work of a high standard, possibly too high for the present extensive areas on estates, but feasible if the same labour force was concentrated on a smaller and more intensively treated area.

#### *Manurial Trial for Nurseries*

The growth of the plants in this trial has been retarded by the very low rainfall during the year. However, it is noticeable that the plots which have had applications of rotted sisal waste, with and without sulphate of ammonia, are more advanced than the plots of any other treatment. The plants in this plot will be lifted and weighed some time in March or April, 1950.

#### *Mulching Trial for Nurseries*

This trial was planted in April and a mulch-cover of fresh wet sisal waste straight from the flume trench was applied in May, after a rainfall of 8.08 in. in April and just before the 1.97 in. of rain which fell in May. The object is to ascertain whether the mulch-cover will conserve enough moisture to influence the initial rate of growth of bulbils in a nursery. The indication from height measurements is that it does benefit the young plants to have a mulch-cover. This trial will be completed early in 1950.

#### *Planting Method Trial*

This trial was planted in April, 1949, to compare nursery plants, produced from bulbils, with suckers from old and new sisal areas. At the same time deep versus shallow planting is being investigated. After only two recordings it appears that deep planting reduces the leaf number but increases the leaf length. It is not known whether this state of affairs will continue with increasing age. The variations in numbers of leaves produced in the three different planting materials are too small to warrant comment.

#### *Dieback Disease*

A dieback of the leaf tips was noticed on plants, which varied in age from six months to three years, and which were growing on red soils in the Thika District. No organism could be found which could have caused the condition, hence samples of soils and leaves from healthy and unhealthy areas were sent for analysis to the Macaulay Institute, Aberdeen. The only analytical figures which appear to suggest a reason for the dieback are the calcium and phosphate contents. The unhealthy soil contains quite a low amount of calcium and this is reflected in the calcium contents of the leaves. The phosphate content of both the leaves and soil from the unhealthy area is low. There is also a high barium content in the unhealthy leaves which may suggest that there is insufficient calcium in the soil. A trial has been designed to be laid out in the near future to test the effects of lime and phosphates, alone and in combination on sisal in the affected areas.

#### *Sisal Waste Analysis*

Waste, produced by dry decortication, from 10-year-old sisal (6th cut) was analysed by the Scott Laboratories. The waste was squeezed in a piece of cloth and the analyses were done separately on the juice portion, which passed through the cloth, and the semi-dried waste remaining in the cloth. The juice represented 59 per cent by weight of the total waste and the semi-dried material 41 per cent.

The following table gives the analyses:—

TABLE II

|                                               | Moisture | Loss on Ignition | Ash  |
|-----------------------------------------------|----------|------------------|------|
|                                               | %        | %                | %    |
| Juice portion .. ..                           | 90.11    | 8.91             | .98  |
| Contribution from 59% of the whole .. ..      | 53.16    | 5.26             | .58  |
| Moist Solids .. ..                            | 79.44    | 18.18            | 2.38 |
| Contribution from 41% of the whole .. ..      | 32.57    | 7.45             | .98  |
| Composition of whole material, as received .. | 85.73    | 12.71            | 1.56 |

|                                               | THE MATERIAL AS RECEIVED, CONTAINING |                               |                  |       |
|-----------------------------------------------|--------------------------------------|-------------------------------|------------------|-------|
|                                               | N                                    | P <sub>2</sub> O <sub>5</sub> | K <sub>2</sub> O | CaO   |
|                                               | %                                    | %                             | %                | %     |
| Juice portion .. ..                           | .082                                 | .034                          | .319             | .446  |
| Contribution from 59% of the whole .. ..      | .048                                 | .020                          | .188             | .263  |
| Moist Solids .. ..                            | .199                                 | .056                          | .332             | 1.275 |
| Contribution from 41% of the whole .. ..      | .082                                 | .023                          | .136             | .523  |
| Composition of whole material, as received .. | .130                                 | .043                          | .324             | .786  |

Calculated on a fibre basis the following nutrients are removed from the field for every ton of line fibre produced:—

- (1) Nitrogen—78 lb.
- (2) P<sub>2</sub>O<sub>5</sub>—26 lb.
- (3) K<sub>2</sub>O—195 lb.
- (4) CaO—472 lb.
- (5) Other minerals—241 lb.

The fertilizer value of the first four items is about £14 at present prices.

It will thus be seen that very large quantities of nutrients are removed by the sisal crop. Trials, which have been designed to obtain information on the use of waste and inorganic fertilizers, will be laid out early in 1950. It will be a long time before accurate information can be obtained from these trials, but the beneficial effect of waste on nursery plants indicates that the return of waste to the field is a practice which should be started.

#### External Trials

The fifth external Cutting and Spacing Trial was planted in October at Dwa Plantations, Ltd., Kibwezi.

The four other trials have now been in the ground for over a year, and so far the records show little variation in growth rates. However, it is noticeable that the trial on black cotton soil in the Ruiru district was the slowest grower during the first year, and it is probable that this was due to the very low rainfall. It is



also evident that the double-row spacing did better than the single-row, a fact which may be attributed to the higher water holding capacity in the broader ridge.

#### *Banding Disease Trial*

A trial was laid out as a  $5 \times 5$  Latin Square on two-year-old sisal in a "banding disease" area. Muriate of potash was applied at four levels, viz.: 110 lb., 220 lb., 330 lb. and 440 lb. per acre in order to ascertain the quantity of potash needed to correct the deficiency in this area.

#### *Acknowledgments*

Messrs. B.E.A. Planting Co. have assisted in the brushing and baling of fibre produced at the Station and Messrs. Anglo-French Sisal Estate, Ltd., have helped with the clearing of an old sisal area and by providing workshop facilities.

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